NOVEMBER 1951

THE SCIENCE TEACHER

- The Quetico-Superior Wilderness Laboratory
- A Ditch, Some Water, A Few Kids
- Leads on Earth Science Source Materials
- Science Challenges Disaster
- What the Ideal Chemistry Course Should Be

JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION

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THIS MONTH'S COVER . . . pictures a group of youngsters "having fun with a little river" one Saturday afternoon early this fall. The river flowed from a tile drain. A little waterfall, a V-shaped valley a foot deep and five feet long, and a sluggish swamp at the lower end of the valley were the initial attractions for the youngsters. Keith Johnson, science supervisor in the Washington, D. C., public schools, came along and snapped a few pictures of the group.

Those who have read the *Cornell Rural School Leaflet* will readily recall Dr. E. Laurence Palmer's plea for "little laboratories for little folks." It was the natural thing, then, to send the pictures to Dr. Palmer with a request to "write us an earth science lesson" based on a simple situation easily duplicated most anywhere. His reply will be found in the article on page 232.

Coming . . .

in the December issue of *The Science Teacher*

- Full details of the Philadelphia meeting
- "Stimulating Thinking through Photography"
- "Common Interests of Business and Education"
- "Elementary School Science Possibilities for You"
- "How Do You Pronounce 'Laboratory'?"

Guided Missives

Editor

The Science Teacher

I would like to take exception to the letter from "Retired Teacher" that appeared in the April issue. For myself I'm glad the person is retired; one with that feeling for the sacred dignity of science should not be inflicted on our public school children. Science should not be apart from all our other activities, set aside by special barriers of dullness and drabness.

To me the new appearance of "our" magazine might better come under the heading of motivation —motivation for the busy classroom teacher who must choose where to spend the precious time allotted to reading. Motivation to attract the elementary teachers that have not had the science background of many people in a field that tends toward specialization.

Of course, I feel that perhaps you, the editor, made a mistake in publishing an unsigned letter. That is not in accord with the policy of most publications. Of course, I also think that "Retired Teacher" should be ashamed to sign his name to such a letter.

Keep up the good work. Let's have more pepped-up issues. They get three times as much circulation in our building as formerly.

ROBERT W. GILLFORD
Cedar Falls, Iowa

Executive Secretary, NSTA

Our state association for teachers will hold meetings for members in three parts of the state the last week of October. I would like to arrange for NSTA representation at each of the other two cities where meetings are held. I will take care of Denver. Would you therefore send me a list of Colorado members and their addresses?

I would like, also, a supply of leaflets and any other material suitable for distribution. We have two science sections in our Denver meeting. One usually has an attendance of well over a hundred. The other is smaller. In Pueblo and Grand Junction the meetings will probably not run more than 25 to 35.

I would appreciate having the names and a supply of literature in time for me to contact the rep-

THE SCIENCE TEACHER

The Journal of the National Science Teachers Association, published by the Association, 1201 Sixteenth Street, N. W., Washington 6, D. C. Membership dues, including publications and services, $3 regular; $6 sustaining; $2 student (of each, $1.50 is for Journal subscription). Single copies, 50¢. Published in February, March, April, October, November, and December. Editorial and Executive Offices, 1201 Sixteenth Street, N. W., Washington 6, D. C. Copyright, 1951, by the National Science Teachers Association. Entered as second-class matter at the Post Office at Washington, D. C., under the Act of March 3, 1879. Acceptance for mailing at Special rate of postage provided for in the Act of February 28, 1925, embodied in paragraph (d), Section 34.40 P. L. & R. of 1948.

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resentatives well in advance of the meetings. We want to do what we can to spread the good word.

GLENN L. GEBHARDT
NSTA State Director
Denver, Colorado

We have published this letter to illustrate the kind of efforts being put forth each fall by the state and area directors . . . one explanation of NSTA growth from 3400 to over 6000 members in three years. *Editor.*

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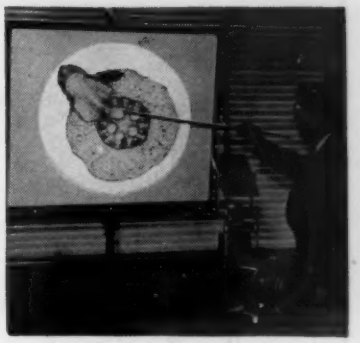

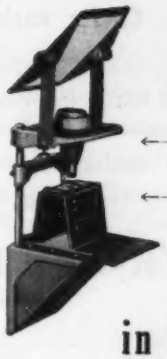

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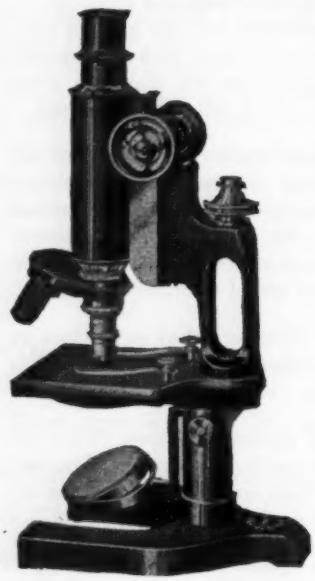

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THE SCIENCE TEACHER

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Editorial

Let's Accent the Positive

This fall we have been reminded that there *are* many things that are right and good about science teaching.

One young man dropped into our office in search of materials that would be helpful to him in teaching elementary science. An ex GI, he had spent the summer in Washington working in a field of science with a governmental agency. He was planning to return soon to California where he would begin teaching a fifth-grade class in a rather small community. His starting salary, by the way, was to be $3800.

And a couple of days ago a young teacher called to ask, "What does NSTA have in the way of information, or leads to sources of information, on the relative effectiveness of the five-period plan versus the seven-period plan in tenth-grade biology?" Ensuing conversation made it clear that she was planning to set up a study seeking to make a comparison in terms of net achievement or gain with respect to such goals as scientific attitudes and problem-solving abilities, and also in terms of rate of gain. Quite an ambitious undertaking, but the young lady bristled with enthusiasm.

Then there was the science teacher from a small, midwestern town who went to the Mills College meeting and attended the NSTA workshop at the University of California. He traveled by bus for the added opportunities to take pictures en route. Back home, he revealed, he teaches chemistry and physics, is "head" of the department, supervises the school's audio-visual program and a squad of 60 student projectionists, and finds time to be active in civic affairs, local and state educational organizations, NSTA, and a regional organization of science teachers. One of his projects this fall will be to shoot all the school's football games and have a 16-mm. print ready for showing on high school night at the local theater the Tuesday following each game. Teaching science is his career; and is he enthused about it! He's planning to be married later on this fall. Maybe that has something to do with it.

In the Swim

No editorial writer worth his salt could fail to comment on the amazing championship surge of the New York Giants. As we go to press with this issue of the journal, it's too early for us to know the outcome of their World Series tilt with the Yankees, but here is our salute to a magnificent performance that makes the series an anticlimax anyway.

ROBERT H. CARLETON

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The Quetico-Superior Wilderness Laboratory

U. S. Forest Service.

By SIGURD F. OLSON

The Quetico-Superior Forest extends for almost 200 miles along the international border from Lake Superior to Lake of the Woods. Once the route of the colorful and intrepid French Voyageurs, fortunes in fur came down its beautiful waterways. Explorers traveled through it in their long search for the Northwest Passage. It has flown the flags of three nations and has been recorded in legend and history as one of the most unique and interesting regions of primitive lake country in the middle west.

Today thousands of modern voyageurs explore it, paddle down the lakes traversed by the adventurers of the past, and pack over the ancient portages that once felt only the tread of moccasined feet. From the standpoint of recreation, historical significance, and economics, this area has become vitally important to the millions of the mid-continent. Here people not only breathe the spirit of the past but experience a scene that is practically unchanged from the days of discovery.

But there are others—the scientists and students of both the United States and Canada—who have found the area a fascinating place. Along the wild waterways of the Minnesota-Ontario border they have discovered opportunities for study and research in undisturbed forests, lakes, and bogs. One of the most interesting research projects of the last few years is the work of Dr. J. E. Potzger, an eminent paleobotanist of Butler University. Repeated borings of the peat bogs of the Quetico-Superior have enabled him to paint a picture of the past, the progression of the forests toward their climaxes, the cyclic successions of growth and decay.

According to Dr. Potzger, the many lakes of the region were formed by glacial action, gouging of the bed rock itself, the damming of streams by glacial debris, or by the melting of great chunks of moraine-covered ice. Peat bogs are lakes that have become filled by the accumulation of vegetation over the centuries. Once I looked through his microscope at sections of his peat borings, at pollen grains from ten to 150 microns in size that were as sharply defined today as they were when they drifted into the lakes thousands of years before. He explained that they were composed of protein surrounded by an almost indestructible outer covering which seemed to defy the processes of decay; that even after long periods of time, it was possible to identify them.

Sigurd Olson is ecologist for the Izaac Walton League of America. He is consultant to the Wilderness Society and to the President's Quetico-Superior Committee. For these reasons, and others of course, he is a scientist whose working (and leisure) hours are spent in the great outdoors. His main beat recently has been the Quetico-Superior area, which is located northwestward from Lake Superior and includes the International Peace Memorial Forest. His article provides interesting and enlightening reading, gives some tips for teaching, and might be a helpful guidance item for bringing attention to still another facet of science.

With degrees from the Universities of Wisconsin and Illinois, Mr. Olson was for 14 years a college teacher and ten years a dean. He served as zoology instructor in the U. S. Army University in England following the war and since then has devoted his efforts to wilderness preservation in the United States.

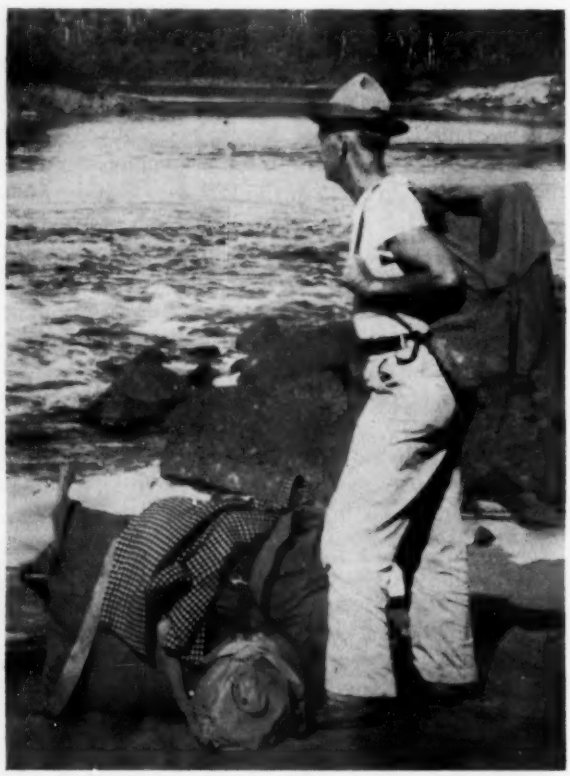
The age of the material from the borings is determined by the radioactivity of the carbon deposits. Time and age can be measured in peat because of the known rate of decrease of the radioactivity of the carbon involved. Dr. Potzger estimated that it has taken from 500 to 1000 years for a foot of such peat to be formed in the old lake bottoms of the Quetico-Superior and that several generations of forest may be recorded in a foot of any boring. Studies such as his are important for they afford an understanding not only of the past but of the present and future. To know what the actual successions have been gives an idea of what they might be in the future. Hitherto, records of forest growth have been scarce, but now we have a known and positive record running back thousands of years. Prediction becomes, therefore, no longer a matter of guesswork but of certainty not only in the Quetico-Superior area but wherever such research is possible.

This interesting work in the great wilderness laboratory along the border is only one of many research projects carried on today. Wildlife management, silviculture and forest management, the varied fields of botany, zoology, ornithology, entomology, and icthyology are being continually explored. In all of these related fields it is becoming more and more evident that complete understanding depends on an undisturbed ecological setting for control purposes. This is a major premise of scientific research.

Wilderness areas are the norms, the common denominators for all investigations having to do with ecological adjustment. Without them it becomes difficult and often impossible to evaluate the significance of change.

With regard to wildlife management, this is particularly true. No program of management can be successful unless there is full knowledge of the traditional environment. Behavior patterns set by countless centuries of adjustment to habitat are the result of a vast multiplicity of influences. Animals do not change their habits or physiological needs swiftly. They react as they do because of ancient backgrounds. It would, for instance, be senseless to consider the wolf without understanding the meaning of the old migration and hunting trails. No one could ever know the answers to the problems of deer, moose, or caribou without taking into account not only their old food and breeding habits, but also the long and intricate relationship between them and their predators. Familiarity with life habits under primitive conditions is therefore the key to successful experimentation. Remove control areas, eliminate the opportunities for observation and comparison, and sound management becomes impossible.

What is true of animal ecology, is also true of plant ecology. Range and forestry problems arise from changes in the ancient environment and are



It is wilderness such as this that the President's Quetico-Superior Committee hopes to preserve for future generations.

usually an outgrowth of our failure to recognize the old relationships of types to climate and terrain. Check plots of original vegetation are necessary in order to know what is wrong. Diseased stands of timber must be compared with healthy primitive stands in order to determine cause. To the plant pathologist, control plots of undisturbed growth are as necessary to successful diagnosis and management as normal individuals are to the practice of medicine. Only through knowledge of the normal is it ever possible to give a true evaluation of the abnormal or the diseased. Scientific investigation based on the all-important wilderness is therefore vital to our forest economy. The productive power of America, leaning as it does on our forests, may be seriously impaired should opportunities for sound research on a broad and comprehensive scale be eliminated.

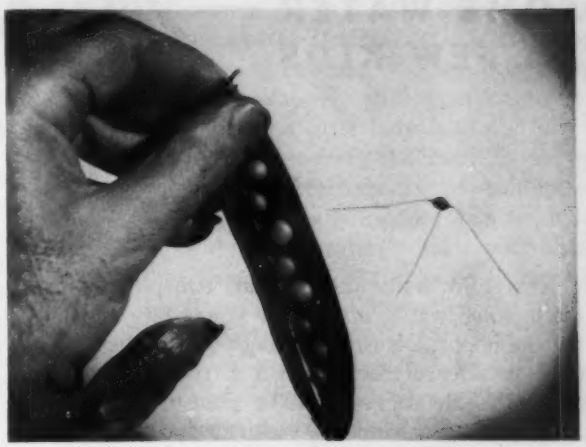
During the past 30 years, conservation groups on both sides of the international border have carried on a continuous effort to preserve the wilderness character of the Quetico-Superior Forest. First came the roads and the promoters who wanted to construct highways into all of the major lakes of the region; then waterpower development which, had it not been stopped, would have raised the levels of some of the lakes as high as 80 feet, destroying waterfalls, rapids, islands, and shorelines; after that, the effort to protect all shorelines from cutting; and finally, the invasion by the airplane which was settled by the now famous Air Space Reservation of the Roadless Areas of the Superior National Forest.

What conservation groups hope for now is that Canada and the United States will ultimately reach an international agreement as to broad conservation and land management principles which will protect the wilderness lake country by zoning while there is still time and guarantee the sanctity of shorelines, islands, and portages. Such an agreement would also insure sound forestry practices, wildlife, and resource management for the entire Quetico-Superior region on both sides of the border. Proponents of this plan recognize that the area, being a geographical unit, must have similarity of administrative policies in order to eliminate threats against it in the future.

In the face of our expanding population and industrial economy it becomes increasingly important to preserve wherever we can such wilderness areas as the Quetico-Superior. From the standpoint of ecological research large areas are necessary, for without distance and space, it becomes impossible to provide the buffer zones which are needed to protect inviolate wilderness interiors from foreign influences. While small regions may suffice for certain types of studies, for the broader biotic concepts there can be no substitute for extensive terrain. This is one of the important reasons for the preservation of this great wilderness laboratory.

How does this apply to the science students and teachers of America who do not have ready access to large and undisturbed regions for study but who, in practically every state, can reach parks, preserves, refuges, and similar natural areas for observation? The same general premise holds: that natural areas, no matter what their size, are nevertheless the controls, the norms in which it is possible to make studies and draw conclusions as to past conditions. All of them are valuable remnants of primitive America and should be cherished and protected, not only as museum pieces but as scientific research areas, for they are our links with the past, our indicators for the future.

What Is It ?



"It"—that spidery object at the right—is the newest type of transistor, a tiny amplifier invented at Bell Telephone Laboratories. Rugged, efficient, and described as the first serious rival of the vacuum tube, transistors can amplify electrical signals about 100,000 times while operating on about a millionth of the power of miniature vacuum tubes. This newest type, called a "junction transistor," has no point contacts. Instead, it consists of a tiny rod-shaped piece of germanium, treated so that it embodies a thin electrically positive layer sandwiched between the two electrically negative ends. The name derives from the "junctions" between the negative ends and the positive interlayer. This type transistor was predicted theoretically two years before its development.

A DITCH SOME WATER A FEW KIDS — *Much Opportunity*

By E. LAURENCE PALMER

Professor of Rural Education and Conservation
Cornell University, Ithaca, New York

KEITH JOHNSON just sent me two pictures of a ditch, some water, and a few youngsters and gave me the opportunity of pointing out the possibilities open to science teachers in a setting such as was pictured. He suggested it be done in 500 words, but in reality it would be easier to do in 500 pages.

Many accustomed to teaching science only with the assistance of a rich library, expensive indoor laboratory equipment, and an abundance of visual aids may be surprised when I say that to teach youngsters such as those shown in the picture on the cover or, for that matter, youngsters many years older, I would prefer the ditch and its water to all the texts, equipment, and aids anyone could possibly present. If we wish to teach the scientific method (who doesn't in these "cockeyed" days?), here is a chance to follow the steps any educator might suggest. Data, check material, opportunity to verify assumptions, and all the other opportunities are there in abundance. To the academic-minded teacher who teaches science for the sake of science, there is rich illustrative material in physics, geology, limnology, physical geography, biology, nature study, and conservation.

Let's be specific about this, however. I assume that the picture on this page shows detail of a portion of the picture on the cover. Let's take a trip down the index finger from its base and on to the middle of that picture. From the base of the finger to its tip, our picture shows territory (marked H on the picture) probably rich in humus and certainly covered with vegetation or penetrated by the roots of plants. We like to think that these roots held the loose surface soil in position preventing erosion. The steep bank shown in the first picture may help us be further convinced on this point.

At about the upper joint of the finger are indicated probably two things. These are two water levels (L and L′) and an area representing deposits made when the water level was higher than when the picture was taken. This is deeply incised by gorges and gullies (G) cut when the water lowered but while there was still wash from the sides. Then, a short distance to the right of the fingertip, we can see the silts deposited under water illustrating a beautiful little continental shelf (C). The little gorges no doubt illustrate well what we mean by hanging valleys draining a small area and therefore not eroding so rapidly as was caused by the greater volume of water in the main stream. Toward the middle of the picture (M) the bottom is washed relatively free of fine silts indicating a moving current of water. The fingertip is possibly three-quarters of an inch in diameter, so the stones on the bottom are not over one-third of an inch in diameter, so the water at its swiftest probably moved from eight to 12 inches a second, otherwise these stones would have been moved.

In the general picture shown on the cover we have the pipe whose length might be known and through which a toy chip boat might be floating and whose speed could be easily estimated. Where the water left the pipe its speed was a little above average judging by the silt-free bottom close by. Going downstream, we have a relatively quiet, deep body of water in which relatively still water organisms might live. Below the little lady with the black cuffs, however, the stream is shallower as shown by the riffled surface. Here the oxygen content of the water may be built up by mixture with air, light penetration will be greater, and swift-water "critters" like stone flies might even be living. If they did live there, we would know that the stream did not dry up during the year since they usually require a year to complete their nymphal stage. With that, we regretfully will have to leave you. Possibly you might like to see the November, 1951, Cornell *Rural School Leaflet*, "Wet Laboratories," which carries the story for 32 pages, or write the National Wildlife Federation, 3308 Fourteenth Street, N. W., Washington, D. C., and ask for some of their helpful material on this sort of activity.

Two Experiments
With Earth Science Education

Here are two accounts of how earth science has been tried, and successfully so, in an elementary school and at the tenth-grade level in a private school. They should provide helpful guidance for similar courses in other institutions. Both papers were presented last March before the Earth Science Institute at the Museum for Geographical Exploration, Harvard University.

After taking the B.E. degree at River Falls State Teachers College, Mr. Wolfe completed the M.A. and Ph.D. degrees at Harvard, concentrating in the field of geology. Besides 25 research papers in mineralogy, crystallography, and geology, he is author of the popular book, *This Earth of Ours*.

Mr. Holcombe confesses to having forsaken the ranks of teachers "temporarily at least." His latest letter informs us that he has just become chief development engineer with Sigma Instruments, Inc., Boston. He holds the A.B. degree from Harvard University and has done special research in astrophysics, geology, and on electronic controls.

At the Elementary School Level

By C. WROE WOLFE, Chairman, Department of Geology, Boston University

Earth science, as a subject, is almost unknown in the Massachusetts public schools. To improve this situation, two conferences on earth science education were held at Boston University and Harvard University in March of 1950 and 1951. As a result of the first conference, Merle Sturtevant, superintendent of schools, Shrewsbury, Massachusetts, invited the author to introduce the school children and the teachers of Shrewsbury to earth science.

In response to this invitation four advanced majors in geology at Boston University and the author visited Shrewsbury for three days in June of 1950. Every member of the fifth through ninth grades, 16 classes in all, spent one class period hearing about their geological environment and handling mineral and rock specimens. After this short

period of introduction each class spent another hour on a field trip to a nearby chosen locality which had been previously scouted by the instructors.

The following lesson plan may seem ambitious in scope for one period of classwork, but the response of the pupils was so avid and intelligent that there was little trouble in bringing the various phases of the lesson plan satisfactorily into their understanding. Since most of them had gardens at home or knew about gardens, the discussion began with "What have you seen in your garden which is neither artificial nor organic?" Soon, the discussion led to rocks; and examples of the various kinds of rocks, particularly those around Shrewsbury, were passed around the classroom. Then, since rocks are usually composed of minerals, the common rock-forming minerals of quartz, mica, and feldspar were shown. Some of the specimens used were beautiful crystalline groups which caught the eyes of the students and awakened considerable interest. A nugget of copper and other interesting specimens called forth many questions and ejaculations.

Leaving the subject of the materials of their environment, the thoughts of the pupils were then directed to the nearby lake, and from that lake the discussion led quickly and readily into the action of the ocean, rivers, and glaciers. The Shrewsbury area shows many features of glaciation, particularly the stone walls, and much attention was given to the sources and nature of the rocks which have been so extensively and neatly piled along these walls.

It is doubtful whether many precise facts still remain with the pupils of the Shrewsbury schools, but there is no doubt that a real and vital interest in the geological environment was stimulated which many of the boys and girls will never forget. The world around them has become a book which many of them will now like to read.

The teachers of the various classes attended the class sessions and went on the field trips with the children. They noted the interest which led to the bringing of scores of specimens from the field for identification. They caught the enthusiasm of the children for the subject and wished that they, too, might know more about it. They also noted that education in earth science can begin at a very early school age. And finally, they noted that the teaching of earth science requires no expensive equipment, for the laboratory lies all around them.

Mr. Sturtevant, the superintendent, Mr. Cook, the high school principal, and all other administrative officers were extremely cooperative in the experiment, and much of the real success which attended it is due to the fine way in which every facility and opportunity was made for introducing the students of Shrewsbury to this earth of ours.

Lesson Plan

SUBJECT. The Earth Around Us.

PURPOSE. To stimulate interest in and awareness of the earth around us.

TEACHING AIDS. Rocks, minerals, crystals, nuggets, relief maps.

PROCEDURE:

A. Short Question Period
   1. Gardens
   2. Phenomena about us—neither artificial nor organic
   3. Origin of soils

B. Rocks
   1. Outcrops of solid rocks—to the universal crust
   2. Kinds of rocks
      (a) Igneous
      (b) Weathering and transportation
      (c) Sedimentary
      (d) Metamorphic

C. Minerals
   1. What are they?
   2. Demonstration

D. Processes
   1. Lakes
   2. Streams
   3. Oceans
   4. Glaciers

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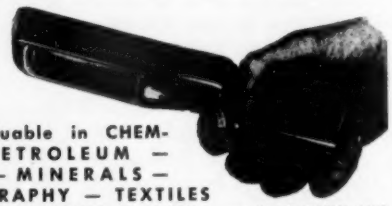

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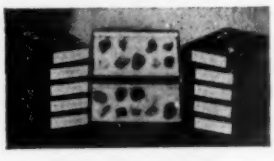

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At the Tenth-Grade Level

By WALDO H. HOLCOMBE, Instructor in General Science, Brooks School, North Andover, Massachusetts

About 1940 it was found desirable from general curriculum considerations to replace the eighth-grade general science course at Brooks School with a rather different course at the tenth-grade level. The official requirements for this course were that it could not overlap too greatly with the chemistry and physics offered subsequently and that it should be suitable for students whose primary field of interest might be other than science. A factor which was not overlooked was that it was to be an elective course and that, as such, it might be important in determining how many students would find science a newly available and interesting field for further study.

After ten years of experimentation with a number of different topics, the course at its present stage of evolution consists of one term of astronomy, one of meteorology, and one of geology. Tried and discarded have been such topics as navigation, surveying, elementary physics, and certain historical aspects of geology.

Early in this development process it was quite evident that none of the available faculty was particularly well trained for this task in a formal sense, but this seems to be quite generally true in secondary science. What has impressed us as more important than formal education is a spirit of curiosity and enthusiasm on the part of the teacher which gets the students taking an active rather than a passive part in their courses.

Since the course was an elective, it was quite essential to keep the subject matter and the method of presentation such that the students would develop a feeling of satisfaction and interest by the time the next lower class was choosing its courses for the following year.

Among the early mistakes in the selection of subject material was the choice of some elementary physics as an introductory topic in the belief that physics as a primary science is essential to the worth-while pursuit of any other science. However, students who have not yet studied geology, for instance, do not necessarily know that they need physics as a prerequisite. As a result our experience has been that the students learn more in the long run if they first develop an interest and a feeling of need for the more basic physics which, in turn, enables the earth science to become more than a superficial story-telling hour or merely a name-memorizing procedure. It would also seem that if a secondary school science is developed and streamlined to higher and higher degrees of efficiency and specialization, it becomes of more and more interest to fewer and fewer students until it finally goes quietly out of existence.

The actual schedule and subject material seems to have evolved to a very teachable state. In the autumn astronomy is taught when the evenings are long but are not yet too cold for outdoor observation. The emphasis is chiefly on the earth as an astronomical body, the constellations for a reference in a study of motions, and those parts of the solar system which are practical for student observation. In this part of the course the student is expected to become familiar with various types of measurement and units such as altitude and azimuth, longitude and latitude, right ascension and declination, and the general requirement that any system of measurement involves a carefully described unit, starting point, and direction.

Emphasizes Personal Observation

Considerable time is spent on personal observations and conclusions which are dependent on these observations. The laboratory exercises, the backbone of the course, range from sketched star maps to a determination of the rate and direction of the sun's rotation. This last is accomplished with the aid of a simple homemade projection telescope consisting of two achromatic lenses mounted so as to throw an image of the sun about four inches in diameter on a small drawing board. Daily plotting of the sunspot locations provides all the needed data.

Meteorology, which is taught in the winter term, is supplemented by a study of daily weather maps, and considerable emphasis is placed on a physical explanation of the nature of heat and humidity and many of their effects on our daily lives.

In the spring term the course is designed to round out a careful geological study of our local area. We happen to be very fortunate in that our school is located in a country area which is unusually rich both in features of glaciation and in an interesting assortment of bedrock. In the classroom the topics studied in detail are determined largely by what the students can actually see in the field. While we realize that we are unusually fortunate in our location, it is our understanding that one of the most exhaustive pieces of geological research was a cooperative effort in a prisoner-of-war camp using such equipment as could be devised with patience and perseverance under such extremely difficult circumstances.

Leads on Earth Science Source Materials for Teachers

SOME scientists and some science teachers decry the disappearance of earth science from the pre-college curriculum. Most science teachers doubt that it will ever return to the high schools as a separate course, except possibly in scattered instances or certain special situations. On the other hand, these same educators see the need and the opportunity for incorporating earth science into the program of science for general education all along the line. It is already "there" in elementary school science, general science, and most senior high school physical science courses. It works itself in no matter whether the bases for the course derive from the goal of "understanding the laws and principles of science," or of "solving problems growing out of the needs and interests of young people," or of "solving problems growing out of a consideration of community resources," and so on. And considering the number of pupils enrolled in the types of courses named above, plus all the attention now given to conservation education, many educators believe that more earth science is actually being taught today than ever before. For all these reasons, and in the belief that improvement in the teaching of earth science might result from an exchange of ideas in this area and from a compilation of source materials, this issue of *The Science Teacher* has been prepared. *Editor.*

1. Following publication of "Term Reports in Earth Science" by Louis Panush, Central High School, Detroit, Michigan, in the February issue of this journal, he received numerous requests from teachers for additional information and suggestions. Here, in brief form, is the kind of answer he gave. "Admittedly incomplete," he says, "but intended to suggest the *kinds* of things that are helpful in enriching the teaching of earth science."

Text References

Harvard Series on Astronomy. Blakiston Company, Philadelphia.

Our Sun by D. H. Menzel.

Telescopes and Accessories by Dimitroff and Baker.

A Dipper Full of Stars by Lou Williams. Follett Publishing Company, Chicago. A very fine introduction. On high school level.

Sun, Moon and Stars by Skilling and Richardson. McGraw-Hill Book Company, New York. 1946. Astronomy for beginners of high school age.

Essentials of Geography by Freeman and Raup. McGraw-Hill Book Company, New York. 1949. College text. Surveys earth relationships, the atmosphere, tools of geography, the climates of the earth and their relation to man and life, and the natural environments of man.

Geology and Man by Landes and Hussey. Prentice-Hall, New York. 1948. College text. Emphasizes the effect of geologic processes upon mankind in the past and now. Good chapters on the history of the earth and the history of life on earth. Practical applications of geology considered in detail.

Geology, Principles and Processes by Emmons, Thiel, Stauffer and Allison. (Third Edition.) McGraw-Hill Book Company, New York. 1949. College text. Fundamental concepts of physical geology and processes that operate on and in the earth.

Meteorology, A Practical Course in Weather by Brands. McGraw-Hill Book Company, New York. 1944. Basic principles and practical applications of meteorology.

Earth Science by Fletcher. (Revised Edition.) D. C. Heath, Boston. 1951. Newly revised edition of the text used in Detroit schools. (See page 264 of this issue of *The Science Teacher. Editor*)

The Earth and Its Resources by Finch, Trewartha, and Shearer. McGraw-Hill Book Company, New York. 1948. Good high school text. Has material on astronomy, map study, the atmosphere, geology, mineralogy, meteorology, natural resources, etc. Many suggestions for reports, projects, and other student activities. (See page 226 of this issue.)

Physiography Lesson Sheets by Nelson. Globe Book Company, New York. 1942. Enough laboratory material to satisfy one lab period per week for an entire year.

Magazines

For the Teacher

Scientific American. Excellent material on most recent advances and research in all branches of earth science and in all other fields of science.

The Science Teacher. The science teacher's journal for suggestions on apparatus, teaching methods, classroom techniques, ideas, etc.

For the Student

Science Digest. For outside reading and reports. Each issue has many interesting materials for earth science students.

Current Science and Aviation. Weekly, eight-page publication, only a few cents per issue in class lots.

Magazine References

Astronomy

"Energy of the Stars" by R. E. Marshak. *Scientific American.* January, 1950: pp. 42-46. An account of new researches in what makes the stars shine.

"The Milky Way" by B. J. Bok. *Scientific American.* February, 1950. Much information about our own galaxy.

"Supernovae" by G. Gamow. *Scientific American.* December, 1949: pp. 18-21. An account of stellar explosions in the Milky Way and the physical processes which have been proposed to account for these cataclysms which occur once in every three or four centuries.

"Greek Astronomy" by G. de Santillana. *Scientific American.* April, 1949: pp. 44-47. Some of the imaginative theories of the Greeks on the motions of the planets.

"Dust Cloud Hypothesis" by F. L. Whipple. *Scientific American.* May, 1948: pp. 34-44. An account of the new hypothesis on how gravitation and the pressure of light may continuously mold stars and planets from the loose dust and gas which fills interstellar space.

"The Great Meteor of 1947" by O. Struve. *Scientific American.* June, 1950: pp. 42-44. An account of the meteor which crashed into Siberia.

"Birth of a Universe" (According to Hoyle). *Time.* November 20, 1950: pp. 84-91.

"Craters of the Moon" by R. Baldwin. *Scientific American.* July, 1949: pp. 20-24. A new study which seems to prove that the moon's craters were blasted by meteorites.

"The Abundance of Elements" by A. J. Deutsch. *Scientific American.* October, 1950: pp. 14-17. A cosmic inventory of various kinds of atoms in the planets, meteorites, cosmic rays, the sun and stars.

Geology

"Soil" by C. E. Kellog. *Scientific American.* July, 1950: pp. 30-39. A brief summary of the nature of soil and the factors which influence it. Principal types of soil.

"Origin of Ice" by G. Gamow. *Scientific American.* October, 1948: pp. 40-45. The causes and periodicity of ice sheets. A new ice age is only a few thousand years away.

"Matching Genesis with Geology" by J. Stering. *School Science and Mathematics.* October, 1950: pp. 637-642. Story of Creation as related in Genesis compared with the same story as told by geology. Author sees no conflict between them.

"Ground Water" by A. N. Sayre. *Scientific American.* November, 1950: pp. 14-19. Water considered as limited resource material. A discussion of the subterranean reservoirs of water in the United States.

"Mapping Mt. McKinley" by B. Washburn. *Scientific American.* January, 1949: pp. 46-49. How survey party scaled the highest peak in North America to locate its features.

"Radioactivity and Time" by P. M. Hurley. *Scientific American.* August, 1949: pp. 48-51. A review of recent findings on the radioactive elements trapped in the rocks which now serve as clocks by which physicists can date events in the history of the earth.

"Erosion by Raindrops" by W. D. Ellison. *Scientific American.* November, 1948: pp. 40-45. The fall of heavy raindrops as very damaging to the soil.

"The Crust of the Earth" by W. H. Bucher. *Scientific American.* May, 1950: pp. 32-41. An account of the findings by new geophysical methods that there may be more activity in the earth's crust than previously assumed.

Meteorology

"The Upper Atmosphere" by D. J. Blumenstock. *Scientific American.* January, 1949: pp. 30-38. A comprehensive review of current explorations of the stratosphere and ionosphere.

"Life of a Thunderstorm" by R. R. Braham, Jr. *Scientific American.* June, 1950: pp. 48-51. The structure of, and stages in, a violent atmospheric phenomenon.

"The Changing Climate" by G. H. T. Kimble. *Scientific American.* April, 1950: pp. 48-53. The climate of many regions on earth has changed during recorded history. What role man has played in this drama and how he may change it in the future.

Demonstration Materials

Much of the materials needed for demonstrations in earth science may be obtained from the chemistry and physics laboratories. Minerals, rocks, and fossils—individual specimens or in displays—may be purchased from Ward's Natural Science Establishment, Inc., Rochester 9, New York, as well as from other mineralogical supply houses. A Trippensee Planetarium, indispensable in teaching astronomy, may be purchased from Denoyer-Geppert Company, Chicago 40.

Visual Aids

Sound Films

"Work of Rivers." Ideal Motion Pictures Service, Chicago. Eleven minutes running time; $2.00 rental fee.

"Ground Water." Encyclopaedia Britannica Films, Chicago. Eleven minutes running time; $2.00 rental fee.

Filmstrips

Air-Age Physics Series—Fluids. The Jam Handy Organization, Detroit.

"Atmospheric Pressure."
"Barometer and the Weather."

Pre-Flight Aeronautics Series—Kit #3. The Jam Handy Organization, Detroit.
"The Air Ocean."
"Air Masses."
"Weather."

The Sky Series—Astronomy. The Jam Handy Organization, Detroit. Although on junior high school level, they serve a useful purpose in high school classes.

View-Master reels on National Parks, mountains, rivers, falls, geologic scenes, etc. Three-dimensional pictures in color to be viewed through stereoscope. Inexpensive. Obtainable at many drugstores. A library of reels can be purchased over the years.

Suggested Projects

Construction of Working Models
(Explain and Demonstrate How They Work)

Sundial
Sextant
Simple mercurial barometer
Locks of Sault Ste. Marie
Geyser (Details and specifications are given in *School Science and Mathematics*, March, 1949: pp. 188-190.)
Grand Coulee Dam or Boulder Dam
Niagara Falls showing dipping of strata and layers of resistant rock over weaker rocks
Anemometer
Electric indicator for wind direction to connect with anemometer. (Details are given in *Earth and Its Resources*—see Text References—p. 71.)

Clay Models or Relief Models

Stalactites and Stalagmites
Caverns—a room in Mammoth Cave or in Carlsbad Caverns
Badland Panorama
Grand Canyon—showing stratification and succession of strata of rocks
Location of a well—above all sources of pollution
Artesian flow of water
Volcano—a chemical reaction may be set up inside of model to show volcanic action
Various types of mountains—dome, dissected plateau, block, folded, and volcanic cones
Deltas, alluvial fans, alluvial terraces, and other physiographic and geologic features

Charts in Color or India Ink Drawings

Positions of earth and its orbit around the sun corresponding to the four seasons, equinoxes, and solstices in the northern hemisphere
Time zones of the world and the international date line
All the phases of the moon
Eclipses of sun and moon
Profile drawings of different types of mountains
Profile of rivers in youth, maturity, and old age
Profile of mountains in youth, maturity, and old age
Anticlines, synclines, faulting, and folding
Stages in the formation of volcanic domes
Hydrologic cycle, showing relation between atmospheric water, precipitation, absorption, ground water, runoff, evaporation, etc. (See *Scientific American*, July, 1950, p. 35.)
Cycle of plant growth (See *Scientific American*, July, 1950, p. 35.)
Schematic diagram showing structural formation of igneous masses
Grand Canyon showing stratification
Summary of all the known facts about the solar system
Common ore minerals—name, formula, per cent of elements, method of mining and extracting, etc.
Geologic history of North America—era, period, crustal movements, life development, rocks, other outstanding physical events
Salt domes
Geologic features and strata in oil well
Geologic features and strata in sulfur well

2. After hearing Herbert B. Nichols speak at the Earth Science Institute at Harvard University last March, we wrote and asked him to tell us what the Geological Survey of the Department of the Interior had to offer on the teaching of earth science, he being the GS Information Officer. A summary of his reply follows.

"I am sending you our latest list of Publications of the Geological Survey. Some circulars listed therein are available to those interested for the asking. The professional papers, bulletins, and most of the maps are sale publications.

"In addition we will be glad to send the following free items upon request to the Chief of Distribution, U. S. Geological Survey, Washington 25, D. C.

Status of Topographic Mapping in the United States
Map A—Shows areas covered by topographic and planimetric maps at scales *larger* than one inch to the mile.
Map B—Shows areas covered by topographic and planimetric maps at scales *smaller* than one inch to the mile.

Map Information Folder—describing topographic maps and symbols
Indexes to topographic mapping for each state and Alaska, Hawaii, and Puerto Rico showing areas covered by survey topographic mapping
Check List of Topographic Maps of the National Parks, Monuments, and Historic Sites
Annual Report of the Director; containing much general information about Geological Survey activities. There is a limited number of copies made available each year.
"Training Geologists: A United States Geological Survey Viewpoint"—Circular 73—by Harold M. Bannerman, assistant chief geologist, and William T. Pecora, chairman, Civil Service Committee of Expert Examiners in Geology.

"In addition to the above, each of the four divisions of GS—geologic, water resources, topographic

mapping, and conservation—will answer requests for general or specific information relative to their activities and often can supply supplemental printed or mimeographed materials.

"Another GS activity which might be useful to teachers of science is our library which contains the world's largest and most complete collection of books and pamphlets on the earth sciences. Most of these items can be obtained by college or public libraries for individuals in need of them through inter-library loan. In addition many libraries are 'depositories' and already have copies of GS publications.

"The Geological Survey does not sell or distribute geological specimens. However, it is possible for schools to purchase geological and mineral specimens from commercial supply houses like Schortmann's Minerals, 10 McKinley Avenue, Easthampton, Massachusetts, Ward's Natural Science Establishment, Inc., Rochester 9, New York, and Minerals Unlimited, 1924 University Avenue, Berkeley 3, California.

"Copies of a bibliography of selected books on geology, mining, rocks, gems, etc. can be obtained from Dr. David Delo of the American Geological Institute, 2101 Constitution Avenue, Washington, D. C. Its title is 'Earth for the Layman' and is their report No. 2."

3. Our own suggestion is twofold: first, do not overlook the numerous maps and pamphlets pertaining to our National Parks. A few outstanding examples are: *Volcanoes of Hawaii National Park* by Gordon A. MacDonald and Douglass H. Hubbard, Hawaii Natural History Association, Hawaii National Park (50 cents); *Zion National Park*, Zion-Bryce Museum Bulletin No. 4; *Ancient Landscapes of the Grand Canyon Region* by Edwin D. McKee; *Devils Tower National Monument*, a pamphlet of the National Park Service. The last-named and other similar pamphlets may be obtained by writing to Newton B. Drury, director, National Park Service, Department of the Interior, Washington 25, D. C.

Second, get yourself or your school on the subscription list of one or more magazines such as these: *National Geographic, National Parks Magazine, Arizona Highways,* and *Natural History.* And then use them. Here are some "how-to-do-it" suggestions based on "Pin-Pointing the Past With the Cosmic Clock" by Richard Foster Flint and "The Cosmic Clock—What Makes It Tick" in the May, 1951, issue of *Natural History.*

Step 1. Obtain enough copies of the magazine so that every two or three members of a class have a copy for reading and study.

Step 2. Use appropriate techniques in the study of the articles—individualized study, group discussion, opaque projection, demonstrations, models, charts, moving pictures, etc.

Step 3. Following the study period, have the students write ten or so separate, declarative statements of "new facts and ideas I have learned."

Step 4. Make a master list of all the statements written by the students, applying, of course, the necessary amount and kind of editing to assure clarity, conciseness, etc.

Step 5. We're headed for an objective "test," and it is now necessary to develop a code for answering. The code will depend upon what is intended to be stressed or accomplished in the lesson. Here is one suggested code: (1) meaning "a true statement according to information given in the articles"; (2) meaning "a false statement according to information given in the articles"; (3) meaning "can not be decided as true or false according to information given in the articles." Another code might be: (1) meaning "true according to information given in the articles"; (2) meaning "true according to information presented in the films"; (3) meaning "true according to the demonstrations and experiments"; (4) meaning "a false statement." Still another code intended to emphasize other learning is this one: (1) meaning "a theory or hypothesis generally accepted by scientists today"; (2) meaning "a theory or hypothesis once generally accepted but largely rejected today"; (3) meaning "a statement of demonstrable fact"; (4) meaning "a false statement." One more suggestion may suffice: (1) meaning "the first quantity or value is greater than the second"; (2) meaning "the second quantity or value is greater than the first"; (3) meaning "the two quantities or values are equal"; (4) meaning "the two quantities or values cannot be compared."

Step 6. Try-outs of the tentative test with other class groups. This, of course, would be followed by revisions and refinement, and so on for many repetitions.

One of the prime objectives in a lesson based on the articles mentioned above might be to bring out the interrelatedness of all the sciences today. In order to "pin-point the past" with an atomic clock, or to understand how scientists do it for us, one must call upon geology, chemistry, physics, archaeology, biology, and probably other fields as well. Here, it would seem, is the potential for a terrific lesson in scientific methods and attitudes or appreciations, in expanded scientific horizons, in understanding what a scientist is and what drives make him click—to say nothing at all of the new factual knowledges to be gained.

What The Ideal Chemistry Course Should Be

By ELBERT C. WEAVER

THIS is a discussion of the ideal chemistry course in the high school. The writer does not teach this course. Neither does any chemistry teacher offer the ideal chemistry course. At times some classroom teachers approach the ideal, somewhat as a variable in mathematics approaches a limit. Our ideal, however, differs from the limit of the mathematicians. In mathematics the variable can approach and practically equal its limit. In chemistry teaching the limit itself moves. Every gain in knowledge of the science of chemistry, every advance in the psychology of imparting knowledge, and every step of progress in the art of teaching chemistry all thrust the limit back.

Nevertheless, the outlook is not a gloomy one. We should accept the implied challenge and enter the game somewhat like a pole-vaulter at a track meet. He has a strong light-metal alloy pole in which he is confident, his coaching is good; and his spirit as a competitor is excellent. Yet he knows that eventually he will fail to clear the bar. This dismal outlook of ultimate frustration does not dampen his enthusiasm for the contest.

Ideally, our students should come to us skillfully prepared to use mathematics and accurate English. Practically, this is never the case. We have to take our students where we find them and lead them along from that point. Sometimes a special student or a special group of students needs individual attention and extra help to patch the background. Then the teacher has to arrange to give this help.

After seeing what some of our formerly less able students can do with arithmetic and the complex provisions of the Social Security law to interpret the law to their advantage, and to calculate their advantage down to the last penny of cash, or down to the last minute of working time, and still remain on the "dole" (speaking of "chiselers," of course), it is safe to say that any student in high school today can do the mathematics of elementary chemistry if he wants to do it.

The precise use of English required by science is another stumbling block. The student who recites, "Oxidation is when you burn something," should be harshly criticized. This criticism will make the teacher unpopular with the class, but it is a calculated risk. The student who writes, "The splinter burned better in oxygen," should also get firm treatment promptly. Quote a few meaningless advertising slogans. A certain automobile is advertised as "bigger and better" —than last year's model? —than their competitors' cars? —than a freight car? —than a kiddie car? Again, Luckyfield cigarettes are "milder and smoother" —than what? —sandpaper? Emphasize furiously the teacher's contempt for the sin of the incomplete comparison.

The teacher's reward for upholding this aspect of the ideal comes at the end of the course. Students write, speak, and think far more precisely at the end of the course than they did at the beginning. They are more careful with definitions, generally using the right sort of terms, although, of course, they sometimes get confused. The facts of chemistry may leave students after a few years of disuse, but the method of thinking and the use of careful expressions in English are permanent gains.

Elbert C. Weaver is a busy man. Following the NSTA summer conference at Mills College he "made" five additional meetings of science teachers and other professional groups before returning to his classroom at Phillips Academy, Andover, Massachusetts, this fall. His talk on "What the Ideal Chemistry Course Should Be" at the Summer Institute, St. Louis University, July 18, was so well received that suggestions for its publication in *The Science Teacher* came to us from a number of sources.

Weaver is chairman of the NSTA Advisory Council on Industry-Science Teaching Relations. He is author of several widely used textbooks in the fields of chemistry and physics and is equally well known for his activities in the New England Association of Chemistry Teachers. He is high school editor of the *Journal of Chemical Education*. Stamp collecting, farming, and "salt water fun" are his hobbies. The Weavers have one son in the Army, one in Yale, one in Phillips Academy, and one in fifth grade.

Illustrations are by Robert Pilgrim, Silver Spring, Maryland.

Quote a few meaningless advertising slogans. Emphasize furiously the teacher's contempt for the sin of the incomplete comparison.

Ideally, the teacher should assign and explain the lesson and then assume that the student has learned it perfectly. Then the teacher could use the lesson as background for new departures. For example, assume that the lesson about oxygen has been assigned and that every student enters the classroom the next day full of detailed knowledge about the method of preparation, the properties, and the uses of oxygen as far as the textbook goes. Then the teacher could illustrate other methods of preparing oxygen. The action of the enzymes in yeast with six per cent hydrogen peroxide, manganese dioxide acting catalytically to decompose hydrogen peroxide, heating sodium nitrate, or the interaction of sodium peroxide with water can be shown.

Practically, no such hopeful assumptions should be made about the quality of the student's self-preparation for the lesson. At this early stage in the course the teacher should demonstrate the preparation of oxygen from potassium chlorate, the details of collection, the effect of the catalyst, and he should take pains to see that the demonstration is a model of excellent laboratory technique.

The ideal chemistry course should be an experience of *learning by doing*. This means individual laboratory work. Each student who studies high-school chemistry should have the experience of laboratory work concurrently with the text study. Sulfur and iodine are both black, six-letter words when printed in a textbook. When these substances are heated in separate test tubes, differences become evident. The laboratory is the only place where the "feel" of different substances can be made real for most students. Otherwise chemistry may degenerate into a long-memory process.

Further, the laboratory teaches valuable by-products. Coordination of thought with action, observing cause and effect, discriminating significant from unimportant events, accurate reporting in a notebook, and certain manipulative skills are gained in many cases. The main value of the laboratory to the writer has been the lifting of materials from the printed page and making them real, and it still is. A useful experiment for beginning students is the heating of lead (or copper) nitrate crystals.

The laboratory is also a place where safety can be taught practically. In addition to an apron to protect the clothing, the use of goggles or a face shield is an obvious safety measure, especially for persons who do not wear spectacles. High schools are lagging in protecting the eyes of students. The Fisher Scientific Company (see advertisement, *The Science Teacher*, October, 1951) has free copies of a *Manual of Laboratory Safety*. Also, the Hercules Powder Company distributes a wall chart on *Laboratory Safety*.

The chemistry course should be full of demonstrations. Ideally, every substance mentioned in the text should be present on the lecture table for the appropriate lesson.

If the lesson is about silica, SiO_2, the possibilities of showing interesting samples are almost unlimited. Show, for example, an Indian arrow point chipped from smoky quartz. Notice also the use of a transparent plastic box (that formerly held cheese) as a container for a sample that is to be passed around the class.

If the lesson is about wrought iron, a sample of early American craftsmanship may be found in an old barn where hitching rings and other wrought-iron hardware were used. The business end of a whale harpoon never fails to attract interest. Incidentally, wrought iron is an excellent topic to integrate chemistry with American history (hardware in the White House that was burned by the British in the War of 1812, marine hardware on "Old Ironsides"). Hydrated copper sulfate, $CuSO_4(H_2O)_5$, crystals are perfect examples of similar solid figures mentioned in solid geometry.

A valuable example of a demonstration from commercial chemistry is the concentration of the valuable mineral from the gangue with which it is mined. Ground copper sulfide ore is mixed with water to which a flotation agent and a frother have been added. When the mixture is shaken, the ore floats and the gangue sinks, because the sulfide particles attach themselves to the froth. The fact that so little material goes to the froth emphasizes the

reason for the rising cost of metals, as well as the need for conservation. A similar separation can be set up with zinc chloride solution in which slate sinks and on which coal floats.

Those demonstrations in which the students participate are probably the best variety. Most of the demonstrations must be shown by the instructor alone because less time is used than with untrained student assistants.

Among the demonstrations that can be performed with the aid of student assistants are: (1) demonstration of the effect of manganese dioxide, MnO_2, on the decomposition rate of potassium chlorate; (2) effect of lead tetraethyl, $Pb(C_2H_5)_4$, on the rate of burning of a compressed mixture of gasoline vapor and air; (3) distinction between *mixing* and *uniting* as demonstrated by a two to one by volume mixture of hydrogen and oxygen.

Demonstration experiments are good ones if they show the point clearly and are quick and simple to perform.

(1) Exhibit materials shown at the appropriate time in the course are always interesting. For example:

(a) Alumina, Al_2O_3, spheres from a ball mill, used for grinding ores.

(b) Riser from a non-ferrous casting, showing shrinkage.

(c) Samples of compounds made in your own laboratory. Mercuric thiocyanate, $Hg(SCN)_2$, made into a cone by the aid of dextrin, forms a Pharaoh's serpent when burned.

(2) Compare the effect of mixing oil and water with mixing Dromus oil and water. A permanent emulsion forms with Dromus oil and water.

(3) Burn a wooden matchstick completely in order to show that the wood is treated, all except at the end where it was held during the process of manufacture.

(4) Carry flame in the hands to prove that flame results from a burning gas.

(5) Hold a match within a gas flame in such a manner that the stick burns but the head does not ignite.

(6) Hold sheets of heavy paper in a Bunsen flame in such a manner that scorch pictures are formed. These show the relative temperatures of the different regions of the flame.

(7) Test for the presence of sodium in dust by a flame color test which is obtained when the fingers are snapped near a Bunsen flame.

(8) Show a green-edged flame from burning alcohol, C_2H_5OH or CH_3OH, to which sulfuric acid, H_2SO_4, and borax, $Na_2B_4O_7$, have been added.

(9) Show the action of baking powder with water. This gives the course a homelike touch that may appeal to some of the girls.

Once in a while an unexpected variation in the classroom routine is as refreshing to the class as it is to the teacher.

(1) Send the entire class to the blackboard if facilities permit. This is a helpful way to learn to write formulas and equations.

(2) Use colored blackboard crayon to advantage.

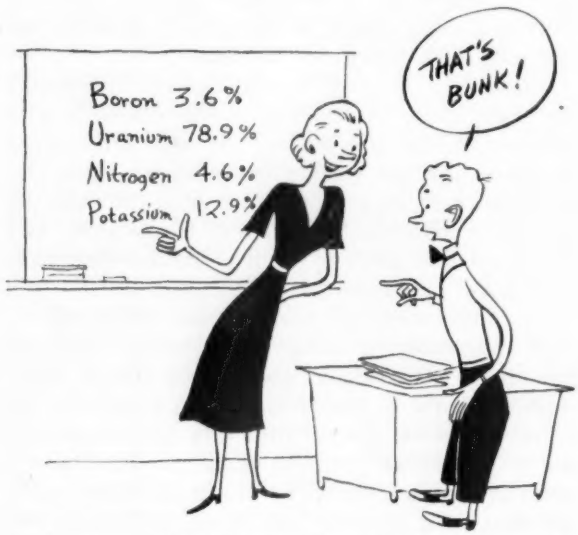
(3) The experiment that shows the crystallization of a supersaturated solution never fails to attract wonder.

(4) The reduction of iron oxide by powdered aluminum, the thermit reaction, is well worth all the fuss and bother.

(5) After the teacher has proved that a compound that contains 88.81 per cent oxygen and 11.19 percent hydrogen has H_2O for its simplest formula, try the "compound" that contains boron 3.6 per cent, uranium 78.9 per cent, nitrogen 4.6, and potassium 12.9 per cent. The answer comes out BUNK.

Teachers of elementary chemistry can help their students by showing them simple mnemonic devices. Indeed, the technique of making such memory aids is a valuable by-product from the chemistry course. For example:

(1) The electrochemical series of the metals follows the name of the fictitious German scientist, P C S Mazintl.



Try the "compound" that contains boron 3.6 per cent, uranium 78.9 per cent, nitrogen 4.6 per cent, and potassium 12.9 per cent. The answer comes out BUNK.

(2) The litmus colors are remembered by the letters shown in the diagram. This device is more effective if lettered in color on the blackboard or in the form of a chart.

(3) The relation of the "ic" acids to the "ate" salts is recalled by the impolite burpy connection.

(4) In the reaction $2HgCl_2 + SnCl_2 \rightarrow SnCl_4 + Hg_2Cl_2\downarrow$

Hg goes from 2+ to 1+, a gain of 1 e^-

Sn goes from 2+ to 4+, a loss of 2 e^-

Tin has *L*ost *E*lectrons; it is *O*xidized. Mercury has *G*ained *E*lectrons; it is *R*educed. This is a mnemonic to end all mnemonics. LEO is Leo the lion, and GER is his roar. You can anticipate a helpless groan from the class when you roar for them, but never thereafter does a single student get confused as to which electron action is oxidation.

You roar for them, and never thereafter does a single student get confused as to which electron action is oxidation.

The course in chemistry should take advantage of modern audio-visual aids. One of the simplest methods of securing free teaching aids is to join the National Science Teachers Association. The Packet Service of NSTA ships free and low-cost teaching aids of surprisingly high quality. All have been evaluated and approved by a large committee of teacher evaluators. Membership in the association also includes six issues of *The Science Teacher* with its "Clip 'n Mail" service for other pamphlets and samples.

Somewhere in the chemistry classroom or on the bulletin board should be placed material that relates to the lesson of the day. These pamphlets, advertising materials, pictures, and news clippings form the background for the lesson. Frequently they stimulate student thinking.

If you have failed to marry a rich spouse, some supplement to your teaching income is necessary.

The course can be varied by the use of charts, moving pictures, slides, and filmstrips. The General Electric Company distributes a beautiful chart of the isotopes. The school service department of Westinghouse has valuable charts especially on nuclear energy. In fact, every teacher should get the catalogue of free and low-cost materials from this source. A chart showing the chronology of important developments in chemistry can be secured from the Mallinckrodt Company St. Louis, Missouri.

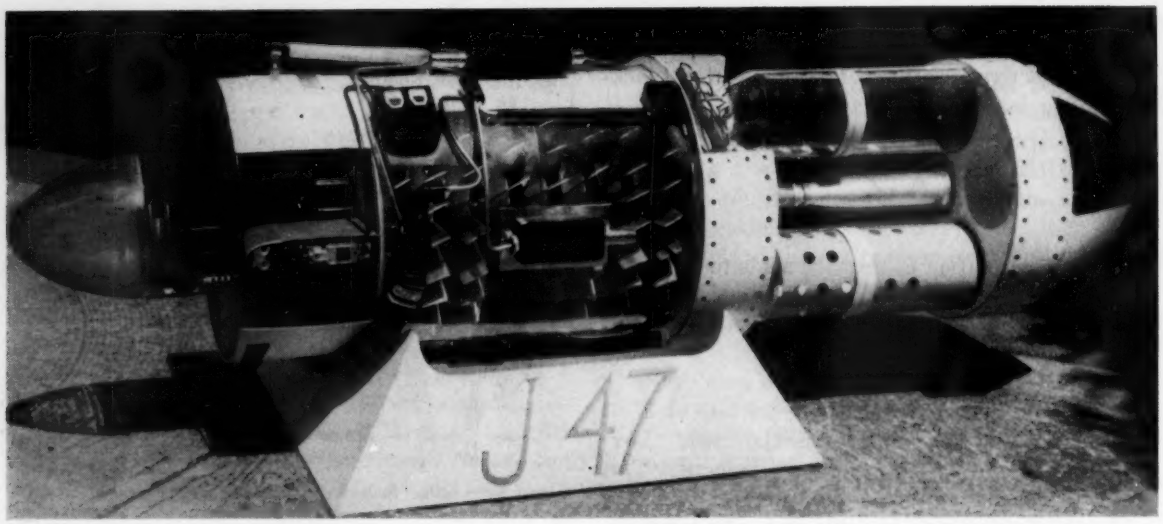
Filmstrips can take your class into a mine or help develop a difficult concept. Filmstrips are a teaching tool of proved effectiveness.

The microprojector can be used to show a number of chemical experiments. The replacement of silver ions by copper when shown by the microprojector reveals surprising beauty of crystal formation. A student microscope plus other apparatus usually on hand in the laboratory is the only requirement to make a satisfactory microprojector.

For motion pictures, consult "Films on Chemical Subjects" plus supplement available from the American Chemical Society, 1155 Sixteenth Street, N. W., Washington 6, D. C., for 50 cents. But remember that motion pictures are an aid to creative teaching. They are not a "mechanical baby-sitter for tired teachers."

Finally, the chemistry course should be a place of employment where the teacher can earn a living

(*See* Ideal Chemistry Course, *page 266*)



MOCK-UPS *in teaching science*

By MARTINUS VAN WAYNEN

The recent emphasis placed on visual aids in education by the armed services should stimulate science teachers to re-examine what they have been doing along this line in their classes. If there is anything to the claim that the armed services can now cover months of grinding in weeks with no loss of thoroughness, we should by all means take notice.

Although the science classroom surpasses other classrooms in the use of visual aid materials, in many instances the science teacher is still handicapped by being forced to use hard-to-see toys such as pulleys one-and-a-half inches in diameter, jackscrews two inches tall, cut-away models that can be seen by only two or three pupils at a time, pieces of lodestone no bigger than a large marble, etc. Such materials are not conducive to the holding of class attention during an explanation. Pupils must see to learn. No one knows better than does a school teacher that 80 per cent or more of our knowledge enters through the eyes.

Good visual aids need not be difficult to acquire. All one needs to do is to resort to that familiar ruse —pupil projects. Suggest a list of possible topics, set up certain construction standards, and watch the visual aids pour in. Of course, teacher advice and guidance may be needed to insure a high-grade product. However, to give credit where credit is due, many of the better examples to be shown later were constructed by pupils with no teacher help at all.

The type of visual aid to be discussed is usually referred to as a "mock-up." Mock-ups may be classified into five classes, as follows: (1) collections, (2) two-dimensional, operational cross-sections, (3) three-dimensional, operational models, (4) breakdowns, (5) three-dimensional, operational actuals.

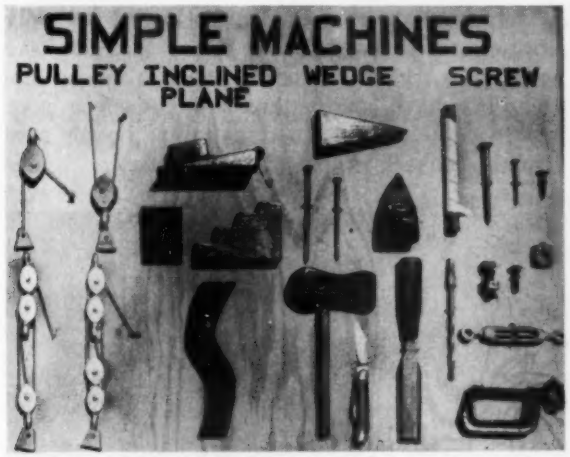
The boards in the photographs reproduced in this article were designed to be the same size as poster board, 26 by 22 inches. This size is easily seen and lends itself well to most projects.

This article shows what can be expected to result when good ideas and enthusiastic students come together. We say "shows" advisedly because of the number of fine pictures John Harville has provided of the mock-ups described by Mr. Van Waynen. The second in this series of two articles will be published in the February issue of *The Science Teacher*. Perhaps by that time some of *your* students will have built some mock-ups in the Van Waynen manner; in which case let us have their pictures (the mock-ups, not the students) to run at the same time.

Mr. Van Waynen teaches physics in the Berkeley, California, High School. Mr. Harville is assistant professor of science and education at San Jose State Teachers College.

The first shown below is a collection of simple machines other than the lever. Two other excellent boards not pictured contained the three classes of levers. Other collection suggestions might feature types of gears, bearings, light bulbs, etc.

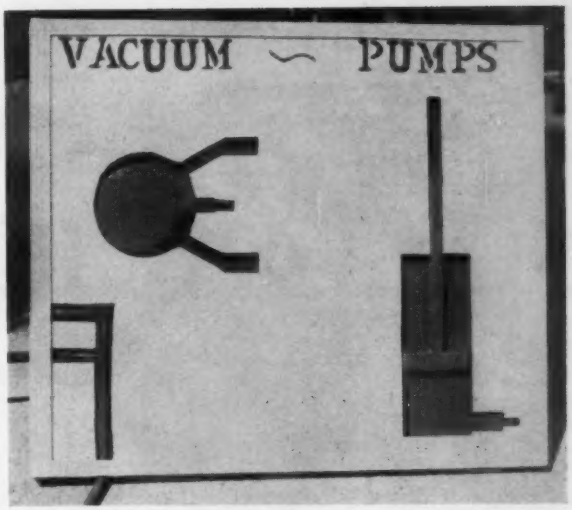
A two-dimensional, operational cross-section is represented in the illustration to the right showing three types of vacuum pumps: the rotary, the piston, and the aspirator. The rotary and the piston types can be manipulated by controls on the back of the board, while the aspirator, being the type used in the laboratory, can be connected to a water faucet and a set of Magdeburg spheres to demonstrate the actual production of a vacuum. Another good board shows the difference between the two- and four-stroke cycle gasoline engines. A light attached on each cross-section flashes on when the piston is ready for the power stroke. These cross-sections



A collection of simple machines other than the lever. Other collection suggestions might feature types of gears, bearings, light bulbs, and the three classes of levers.

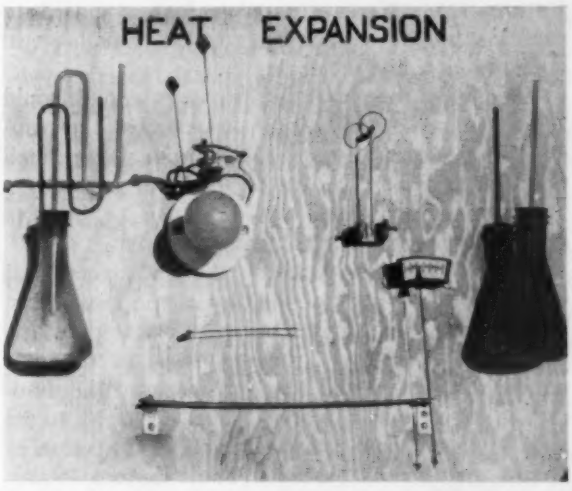
are built up of small pieces of wood and the pistons can be operated by controls on the back.

A three-dimensional, operational mock-up is shown in the next illustration. This is a most versatile board. When the metal strip is heated, its expansion is shown vividly by the moving pointer which it activates. Above and to the right is a flask of colored water which, when heated, expands into the tube attached. At the left is a flask which, in a similar manner, can be made to show the expansion of gases. Below the light bulb is a small compound bar and above it to the right is a sensitive thermostat element. The lamp is connected so that its heat will cause the thermostat element above it to move, tipping a mercury switch and opening the circuit. The lamp goes off and on continuously creating a great deal of interest.

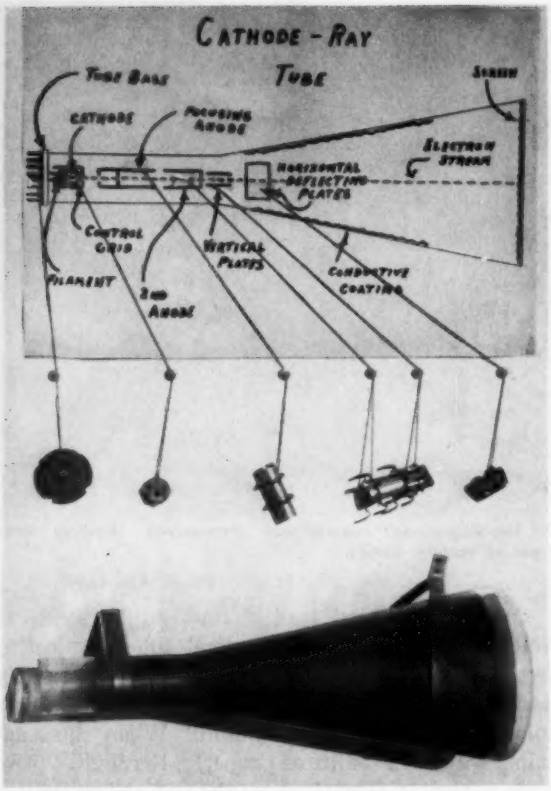


A two-dimensional, operational cross-section showing three types of vacuum pumps.

On another board (not pictured) three tubes of different diameters, with vertical tubes projecting from them, were joined together with smaller tubes and corks. These in turn can be attached to a container filled with colored liquid. When this container's height is adjusted properly, Bernoulli's principle is clearly illustrated by the decreasing heights of the liquids in the vertical tubes. This is a very effective demonstration. Still another shows a compound-machine arrangement consisting of an inclined plane, pulley system, wheel and axle, and gears. This device does a good job of teaching mechanical advantage. Another board shows electrical energy being converted to heat and heat being converted to mechanical energy. It is possible in this case to set up a problem in over-all efficiency.



Three-dimensional, operational mock-up—a most versatile board.



Clarification of the principle of the cathode-ray tube. Boards of this kind can be used to great advantage by small groups of pupils.

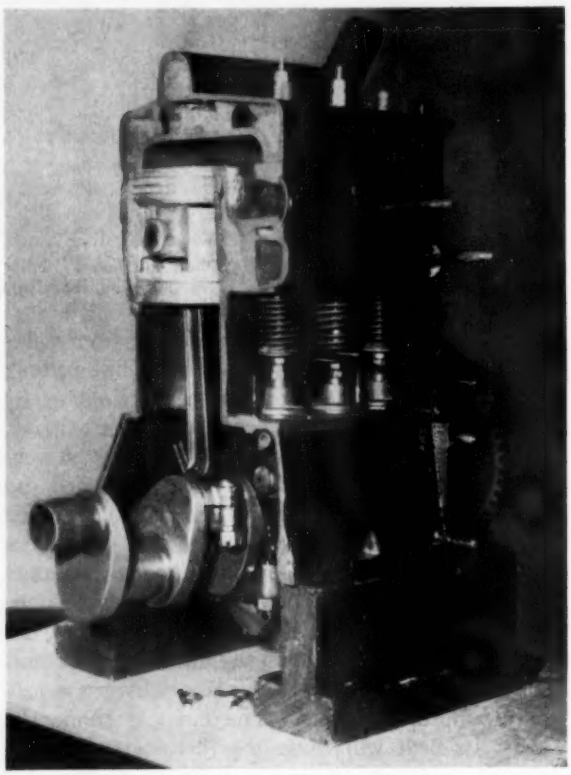
The illustration on page 244 shows an operational model of a jet engine and demonstrates what can be done with bits of plastic, cardboard, etc. Of course, this model represents a lot of work. However, the pupil who made it displayed talents which might otherwise have been discouraged and forgotten. Future pupils have acquired a high standard to pattern after, as well as an excellent visual aid in their study of the jet engine.

The breakdown shown in the picture above should suggest many others. This one clarifies the principle of the cathode-ray tube. Although the small parts on the board are rather difficult to see by a large group, boards of this kind can be used to great advantage by small groups of pupils.

Three-dimensional actuals take up a good deal of room but are perhaps the best of the visual aids. In these we have Pascal's law illustrated in the hydraulic brake, gear systems as used in the automobile differential and transmission, and the automobile engine cutaway and opened up for all to see and operate. Our list also includes two smaller boards, one having three St. Louis motors—series, shunt, and with permanent magnets—ready to operate at the flick of a switch, while the other is so arranged that a single cell can be made to operate a relay but not a sounder. By closing a switch, cutting in a six-volt source, the sounder will operate through the relay. Others, also operational, contain all that is necessary to explain fluorescent lighting, automobile ignition, and the difference between the diesel and the conventional gasoline engine. In the latter, light bulbs depict the explosions.

It was difficult to choose one of these boards to be pictured here. However, on the basis of interest shown by the class the cut-away automobile engine was chosen and is shown in the next illustration. In this model the action of the piston can be clearly seen and demonstrated. The shaft can be rotated to show the action of the valves, camshaft, gears, and driveshaft. Since the top is removeable, the second piston can also be seen to operate, as well as the upper part of the valves.

The photographs used in this article are only representatives of what can be done. Why not have your pupils try their hands at it? Do not be surprised if some of your better boards come from your weaker pupils. Remember that these boards save your time as well as that of your pupils.



Three-dimensional actual of an automobile engine. In this model the action of the piston, valves, camshaft, gears, and driveshaft can be clearly seen and demonstrated.

Science Challenges DISASTER

By ROBERT TYSON

AN atomic explosion would blow the ivory tower sky-high together with more worldly structures. Scientific detachment has been dispelled like a whisp of fog at a time when crisis has literally become routine.

The science teacher, like many other people, may be sorely tempted to sum up with three words: "What's the use?" In reality there never was more responsibility for maintaining high morale. Today science is in the front ranks. As scientists, let us briefly examine the facts.

1. THE THREE "GUILTS." WHAT DO THEY AMOUNT TO? In the search for a likely scapegoat for the world's predicament science is a prime target. Guilty or not guilty?

Count one: science is too "materialistic." Leaving the truly deep aspect of this horrifying indictment to philosophers with time and mind equal to it, two comments are offered.

Staying alive—an abysmally materialistic pursuit if there ever was one—is the first task of living organisms. It would seem to be no crime to accomplish this aim efficiently and, if possible, pleasantly. Judges of American ways once felt that culture and sanitary plumbing were mutually exclusive. Apparently they have reconciled the two trends and now make energetic efforts to obtain more of our modern devices, possibly to scorn them at closer quarters.

Some childishly simple reflection shows that a surprisingly large number of us today owe our ability to reflect at all to some decidedly materialistic advances in medicine. Without them we might be notably dead.

Count two: science is responsible for our destructive weapons. Without avoiding the responsibility of *every* voter—not merely those who are also scientists—let us plead the truth rather than the guilt of the indictment. In World War II our weapons helped win against nations which most fortunately could not equal our destructiveness. Perhaps an undefeated people does not fully appreciate that vital military victory.

It has been pointed out often and correctly that developments which increase destructive potential can also contribute to a better peaceful world.

Count three: scientists lack social consciousness. Many did and doubtless some still do. But a glance at reports of recent scientific conventions proves that awareness of social responsibility is rising steeply. Social science, for example, is amassing skills and experience for a precision attack on problems of human relations. Specifically, international tensions themselves can now be approached in a manner at least somewhat more scientific. What could be more socially practical than the scientific method thus applied?

2. REDUCING THE CULTURAL LAG. It is a truism that knowledge outpaces present application for the good life. Even psychology, a child among vener-

"Science Challenges Disaster" will challenge—at least stimulate—*you.* You can use this article in thinking about "why teach science?"; you can use some of its ideas the next time you make a speech about your work. We believe you'll be glad it found its way into our journal. But if you disagree with any of its points, let us hear from you. The author, too, will appreciate your comments.

Now assistant professor of psychology at Hunter College, New York City, Dr. Tyson has had long experience in personnel work and mental hygiene. He served as personnel testing officer in the Army of the United States during 1942-46. He holds the B. A. degree from Yale University and the Ph. D. from the University of Vienna. Among his publications is a translation of *Gestalt Psychology* (by D. Katz) from the German. Dr. Tyson is currently a member of the advisory staff, *Journal of Education.* Mrs. Tyson, Dr. Mary C., is a practicing physician.

able companions, offers modest but definite suggestions that could now be put to better use and—what is far more significant—has methods for solving or partially solving problems approached so far in a haphazard manner. Science teachers are obviously centerstage, front, in giving growing minds the information and attitudes that can help lessen the gap between information and society's willingness to employ it.

3. SCIENCE ASKS THE MOST IMPORTANT QUESTION IN THE WORLD. Even in more placid times we must make decisions that affect our entire personal lives. Today we play a part in deciding issues of world-wide significance. It is science that can help us find the most appropriate solutions by asking a vital question in just four words: *"How do you know?"*

Too few people realize what hypothesis means, as opposed to a verifiable conclusion. The convincing writer and the clever debater claim too much attention and command too much action. Only recently have we begun to see that "wishing makes it so" is far more than the title of a song.

More reliable tests of values have a place in the vast field of human relations. Controlled observation, with statistics, logic, and the laboratory, enable us to ask, "How do you know?" with at least some optimism. The scientific method, finally applied to personal and interpersonal problems, originated in the truly exact sciences. For this reason mathematics, physics, biology, and the other disciplines have much to teach about life outside the classroom.

Every single day the newspaper, radio, television, and the ordinary events of the school and community give us material with which to make a seemingly remote lesson lively. It may consist of a news item about an opinion, an admonition, a problem, or a conclusion. Let us look at the scientific method in today's laboratory or classroom work and then take five minutes of the hour to show how it helps ask, in a specific instance, that central question: *"Do they know? How?"*

4. PROBING THE DEEPEST MYSTERY—OURSELVES. Clear logic is admirable. It is the scientist's most cherished possession. Unfortunately, just as in the case of an automobile in perfect condition, the outcome of its use depends on the human user. Logic may be perverted. The automobile may be wrecked. The cool thinker of the laboratory can be an emotional problem to his family and use prejudice instead of reason at the polls. One task of science is to help us know ourselves for our own advantage.

Those who ply the enviably exact sciences are entitled to reservations about the state of the newcomers, psychology and psychiatry. What may not be realized fully is that many, perhaps most, psychologists and psychiatrists feel likewise and are trying their best to become equals in precision rather than emulators.

The clinical method and the field study are not chosen by preference, but because they are often the only approaches available at this time. Nevertheless, when the psychologist who studied the unholy group at Nuremberg suggests that we also observe other totalitarians to whom we have access, we all appreciate the wisdom of his proposal. It is so obviously worth-while to try to discover what creates a Hitler and a Stalin.

5. ATTITUDES THAT BUILD COURAGE. None of us expects students or colleagues to react with the regularity of chemicals in a test tube. Nevertheless, we can safely review the general principles which, by and large, favor good morale. Eight items may be mentioned: (1) reality honestly faced, no matter how difficult it may be—no "Pollyanna"; (2) activity—preparation and practice for an emergency, rather than worry; (3) perspective—a view of years and decades, instead of focus on one trouble; (4) talking it out—discussion of fears, with no thought of the outmoded "stiff upper lip"; (5) a problem-solving approach—really the scientific method—for everyday problems of human relations; (6) the teacher's example of courage; (7) a philosophy of life, perhaps religious, which lends support; (8) determination to preserve our scientific freedom to follow where the facts lead rather than where a dictator may direct us.

6. TRUE SCIENCE IS DEMOCRATIC. Authoritarianism is deductive; its conclusions are determined from above. Genuine democracy—by *our* definition—is inductive. The people set up their own authority and can *up*set it at regular intervals if they so desire. And in a sense a scientific experiment is a perfect model of government by the people. The facts revealed may "vote" unanimously, as they often do in physics and chemistry. Or the "returns" may show a "majority," as they frequently do in the social sciences. The next "election," in the form of a new investigation, may reverse the findings. But whatever the result, science, like a population after going to the polls, adapts itself accordingly. The scientific method is a discipline which demonstrates the very essence of a free society!

All the sciences are needed, and all must act collectively to mount their forces for an attack on our greatest single problem: a scientific attitude toward man. Teachers of science are prime factors in this mobilization. Was there ever less time to feel futile?

A New Approach

to the physical sciences

By HAROLD E. TANNENBAUM

We know that this will be a controversial article, which is one reason why we are glad to print it. It deals with questions that somehow or other must be answered. Are physics and chemistry as high school courses "headed for limbo along with Caesar and Virgil"? Should these courses be "saved"? If not *in toto*, which portions are worth saving? If out they go, what replacements come in?

Mr. Tannenbaum is head of the science department in Elisabeth Irwin High School, New York City.

As WE FIND ourselves faced with the ever mounting tensions of our modern society, it is natural that we pose the question of the role of the school in these troubled times. Many of us have always believed that the function of the school is to help the young people of our country to become responsible and rational citizens in a free (but very complex) society. And the acute problems of our times only deepen this belief. If our position is sound, then the curriculum for the school must reflect this particular function. John Dewey in setting up the school for such a functional task has implied a curriculum based upon the needs of the young people to be educated. Apparently, information, per se, is out. And, in that case, physics and chemistry are among the "outs."

But those of us who teach the physical sciences sense an error in this reasoning, and we rise to protest. Where is the error? As we look at our society, we see a world built upon the physical sciences. All that fits into the world, fits by leave of the technicians. Certainly, we argue, an understanding of this physical science is essential to the person who is to live with technology. But both the facts and the curriculum makers argue against us. The enrollment in the formal physical science courses of the high schools are nowhere near the enrollment of the school, and most of our young people receive no information in the physical sciences (of a formal nature) beyond the work which they do in the junior high school general science courses. Furthermore, the requirements for the courses that are given are becoming less and less stringent. It looks as if physics and chemistry are headed for limbo along with Caesar and Virgil.

Technology—Its Role in Our Lives

But let us look again for the error which we sensed. We all agree that our world is molded by technology. But we know that technology molds nothing. Men mold. Men act. Men make the changes. Technology is what is molded, and, rather than technology being a determinant, it is a resultant. Cottrell, in his examination of our social institutions, has said:

> Technology as a system gains momentum, but society can set the limits within which it will function at any given time.

We, who are the determiners, must make the decisions. And, if we believe in a democratic philosophy, this means that all of us must make these decisions together, or they will be made for us. Again Cottrell has put this clearly:

> Youth will have to see the choice before all citizens either of playing their part in the effort to make this economy function in terms of democratic principles of wide consent and participation or of allowing the mechanisms which we have to be manipulated and controlled by a small and ultimately dictatorial minority.

This situation, real as it is, can lead us into some unsound thinking. Many have said that in the light of this need for an understanding of our technology we must teach our physics and our chemistry. They have argued that we must teach these subjects so that our students can make the intelligent decisions necessary to participate in the democracy. But reality soon topples this kind of argument. We have been teaching the traditional physics and chemistry for a long time, and they do not seem to have brought about that "wide consent and participation." In fact, Cottrell wrote his material as part of a call for a new high school curriculum.

It is clear that even though these traditional courses are not satisfying the needs of the vast majority of our young people, these young people do need an opportunity to examine and make judgments upon the problems which technology raises for them both in their capacity as individuals and in their capacity as citizens.

Science and a Philosophy of Life

The solution of this dilemma seems to lie in the application of the Dewey philosophy to the particular needs of adolescents. Both Taylor (E. B. Taylor—*Do Adolescents Need Parents?*) and Corey (*Eighth Yearbook—John Dewey Society*) in examining the needs of adolescents have found that there is strong and vital need on the part of the young people to establish a set of personal values or a basic point of view.

It is in the light of this need for establishing a basic philosophy that we must do our thinking about the curriculum. In this day and age we cannot think about our world without having some ideas about the interrelationship of science and technology with the rest of our civilization. This technology is a part of the warp and woof of our society, and all of us are under its influence. Can we teachers face up to what is implicit in this situation?

Of course, there is the group that has the need for science from a professional and vocational point of view. But this group is a minority group. Furthermore, the trade, technical, and professional schools are doing a fairly good job of teaching science material to this group. It is important that we realize, however, that this group also needs a chance to place this scientific information in an overall philosophic setting. They must also have a chance to establish their own personal values.

It is not the problem of this minority group, however, that needs our attention. It is rather in the light of the need of all people to establish a personal philosophy that science must be fitted into the curriculum.

Some Possible Areas of Study

For most of us "$F \propto A$" or "$S = \frac{1}{2}gt^2$" is of no consequence. Certainly we who work in the field of science know that an understanding of these relationships has helped us to build our technical society. But most of us say, "So what?" What is significant? Perhaps a study of electric power has significance for us. What is this power for? Who owns it? Do we need more? How can we get it? What is the role of government in this problem?

Or, to look at another example, we may find concern with the problems raised by machines. We can ask about our mass production devices. What about our electronic controls? What about our conveyor belt systems? What about our use of specific gravity methods for coal separation? Or what about our magnetic devices for concentrating ores and making use of low-grade ores economically feasible? What about chemical flotation methods for separating one ore from another? What do these devices do *for* us? What do they do *to* us?

Then we can look at our cities. We have all of our modes of transportation and communication to consider. Such questions as how and where do we build roads and bridges and tunnels come out. And there are radio and television and newspapers and telephones and movies to think about. But let me hasten to add that we must look at the social phases of these problems as well as the scientific phases.

There seem to be four or five areas which offer us excellent possibilities for the development of this type of curriculum. These can be listed as follows.

1. Mechanical power and energy are determinants of a technological civilization, and a study of the social and scientific aspects of the problems which rise out of power production can lead to a rational solution of these problems.

2. Machines are the methods by which we employ our mechanical power. In order to know what our civilization can be we must know what machines are doing, and can do, for us—and to us.

3. A consequence of our technological age is our closely interwoven and interdependent civilization. What has technology done in the way of transportation and communication, and how has this altered our way of life?

4. The materials from which we make our goods are a major factor in the kind and amount of goods that we shall have. Do we want to use our resources this way or that way? What can the physical sciences show us about the use of resources? And, more important, which way do we want our resources used? We must make up our minds on this question, and so we must have the facts with which to judge.

5. The area of personal well-being has been greatly affected by the application of technology both to the production of foods and to the production of drugs. For many groups this area offers a potentially important subject for study. (It is, however, one that has not come up for consideration in the course in the Elisabeth Irwin High School.)

All of these areas are in the realm of "man made" uses and changes in our environment. These can be explored and must be spotlighted from many points of view. The science must go with the social science and with the aesthetics and ethics of all these problems. Looking at problems must be the business of the school, and we must examine these areas with "no holds barred." We don't need to have answers—in fact we must not give answers; that is not the school's function. But we must look at the problems. Of course, they are controversial, but if we want intelligent answers from our citizens, we must let them have all of the facts.

Implementation of the Program

The implementation of the above-outlined program is far from simple because there is no single method for satisfying all schools and all people in their search for materials from which to build a social philosophy. However, we of the Elisabeth Irwin High School have been considering the problem for the past several years, and some of the materials which have come from our work are given here to demonstrate one possible course of action. We will limit our illustration to some of the work which has been done in the areas of mechanical power and machines.

"Physics" is offered to the twelfth grade group, and it is a laboratory, class discussion, and lecture course. With us, however, each of these three course areas has a special meaning. Lectures may be by the teacher, but that would not happen very often. Mostly, the students themselves give the lectures. And the lectures are solidly prepared and planned. The lectures and related discussions on the power problems of the northwest took six 45-minute periods. These lectures were prepared by two students who included a movie in their presentation. The materials for this report were available from government (Bonneville Power Authority, Department of Interior, Army Engineers, and Congressional reports) and private (Water Conservation Conference, C.I.O., and Edison Electric Institute) sources. These were obtained from materials that were available by writing to these various agencies. Once started from materials which the teacher had on hand, students were able to go ahead on their own and find much more.

These kinds of reports led to some very interesting and important discussions. Some of these were recorded on tape, and an analysis of them shows a wide range of concerns. The young people had an alert awareness of the problems implicit in our power-oriented society. The ramifications of power into all phases of our lives they took as a part of living—and they were eager for the opportunity to think through their own positions.

Nor were they rigid in their positions. As part of a discussion, one girl gave a short report on the TVA. She had made a study of it as her individual report. A boy pointed out the problem of natural monopoly. His comment started a small discussion which is typical and is included here:

SPIKE: I understand that it (the electric power industry) is a natural monopoly in many ways; but still I think it should be controlled for the benefit of the consumer and not so that the producers of power can make enormous profits.

TEACHER: Do you personally see a solution to that problem? You said that on the one hand it was a natural monopoly, and that on the other hand you wanted it controlled for the benefit of the consumer rather than for the benefit of the producer. Do you see a solution to that problem, and if so, what is it?

SPIKE: There should be increased reductions in the price of power by regulating commissions.

CARL: I ask you, Spike, do you think that TVA fits the bill with regard to regulation?

SPIKE: Yes.

A further discussion came with regard to public ownership:

JOHN: I think there is a great danger in becoming too socialized because I think the individual loses a lot of contact with his government if everything is controlled for him. If the states control the electric power in their own states and the electric power is not used by anything outside the state, the federal government should not interfere.

TEACHER: In other words, what you are saying is that a state power commission is adequate to handle the problem if the power is used within the state, and you are opposed to federal or even state ownership of power production plants.

JOHN: Yes, that's right.

DICK: I think John is stressing the importance of the individual to the degree that a few individuals on the board of directors of some power utility have complete domination over the power for all our lives. I think that's wrong.

JOHN: Well, if the power is socialized, then a few individuals in the government will have control over all the power in the whole country and not just in a single state.

IKKY: Well, through the TVA, I think the contact between the government and the individual has been brought much closer.

These young people were thinking, and they were thinking together. The summary of this discussion seemed to indicate that the majority of the group favored strong control or outright ownership of the power industry by the federal government. However, a few still held out the danger of too strong a centralized government. It is important to see the interplay of ideas.

John feared government. He wanted very little control of industry by government. But Dick felt that such a situation would favor the few rather than the many. And then Ikky came in with some evidence. And this is the way it went on.

In the long run, these young people came to see a foundation for their positions. And they grew to be able to listen to (and hear) various points of view. An interesting aside is the comment of John's father. He was concerned about John's arguments for "socialism" at home. When he heard the tape he said, "You know, those are some of the same arguments we had at home. But what John said in class is what I said at home." John was looking for a position (of course he was also teasing his parents), and he was thinking it out with his peers and with his parents.

Laboratory Work and Projects

Finally, there is the laboratory work. And this laboratory work ranges far and wide. Some people may be tearing down—and then rebuilding—small gasoline engines. Others are building working models of steam engines. Others are out studying the bridges and tunnels of the city. Others are building radios. Others are interviewing officials of Consolidated Edison and of the State Power Commission. The laboratory is where experiences are to be had. And the job of the teacher is to help the young people find the experiences and exploit them. This laboratory work is the most exciting part of the job in that it requires finding material for research jobs that can be done by the members of the group and yet are related to the world of real things with which young people are concerned. Several very interesting projects have been developed, for example: Bridges and Tunnels of New York, Electric Motors in Factories, Clocks and Watches, The Private Power Industry, The TVA, The CVA. These reports, which include both the science and the social science of the questions considered, become the basis for the lectures which individuals give. As an example, the following quotations are from a report on the motion picture industry:

> The motion picture camera is basically very simple. It consists of a light-proof box with a lens at one end and a celluloid film, sensitized to light, at the other end. A shutter is placed in front of the lens which is opened when a picture is taken. When the shutter is open the light, passing through the convex lens, casts a real inverted image on the film. In the motion picture camera a series of these pictures are taken at one time. The shutter opens and closes about 16 times a second. The film moves when the shutter is closed and remains stationary when it is open. The films are made up of reels about one thousand feet each. One foot of film moves past the lens every second, so that one reel contains about 16 thousand pictures. . .
>
> Few people realize the importance of the motion picture industry. The screen is taken for granted as a part of daily life, and few are aware of how rapid the progress of the motion picture has been. In little more than a generation it has grown from the peep show, a mere visual novelty, to a new and vital art. . .
>
> The motion picture industries of European nations were slowed down, if not actually stopped or damaged, because of the first world war. Since then American films have flooded foreign markets, hindering their industries from developing. American pictures have spread our culture and our ideas to other nations and have influenced them in adopting our dress and habits.
>
> The motion picture is equally important in our lives. Some think of it solely as a source of entertainment, but today the film is becoming more and more popular as an educational method. Behind it is a gigantic industry, supporting thousands of people who rely on it and connected industries. Today the screen is able to bring to a vast popular market every service of entertainment, information, and education. In the future it will not only progress technically but in finding new spheres of usefulness to society.

It is true that this program places much emphasis on individual work. It is true that many areas of factual information do not come to the students. And yet, as we see it, the information which students obtain has a significance for them and finds a real place in their lives.

If we add it all up, what we are saying is that we feel that the key to the teaching of physical science at the high school level lies in the presentation of the material in such a way as to help the young people start to formulate, within their own philosophies, the role that science must play in our society. We want our young people to recognize science for what it is—a tool which men can use.

As young people experience this type of program, it is our hope that they will decide for themselves how they, as individuals and as citizens, will have this tool used.

The Readability of High School Science Texts

By GEORGE GREISEN MALLINSON

THE attention given to the problems of vocabulary and reading difficulty in textbooks for high school science is not recent in origin. However, one will not find complete agreement among science educators with respect to the problems. This latter statement is most clearly evident in the articles by Malatesta [1] and Sister Payne [2] that appeared in recent issues of *The American Biology Teacher*. As a result of examining certain textbooks in biology, Malatesta made this comment:

> It (the book) consisted mainly of difficult scientific terms with equally difficult explanations. There was little to fire the imagination of the average student and lead him into what can be the wondrous field of nature.

Sister Payne, however, made the following challenge to the comment of Malatesta:

> Why should scientific terminology be simplified for him (the student)? Why substitute "simple words" or slang phrases for distinctive, scientific terminology that is purposeful and pointed? Why step down educational levels? We need not assume that the present generation of students is endowed with less ability than the parental generation who passed similar courses. Do we not insult both parent and progeny by catering to mediocrity?

It is platitudinous to state that the comments of both Malatesta and Sister Payne have merit. Yet it seems to be a complaint common to all teachers, that in nearly all classes some, and in some classes many, students are unable to read with understanding the science textbooks issued to them. This of course raises a number of questions: (1) Are students receiving adequate instruction in reading, or are textbooks in science too difficult for the students for whom they are designed? (2) Assuming that levels of reading difficulty of many textbooks in science are too high, what can be done by the teacher to help the student to read them with greater understanding? (3) What are some of the measures that can be taken by publishers of textbooks in science to solve the problems of vocabulary and reading difficulty?

The answer to the first question is not so simple. First, the point raised by Sister Payne, i.e., "We need not assume that the present generation of students is endowed with less ability than the parental generation who passed similar courses," needs some qualification. It is probably quite logical to assume that the present generation is on a par intellectually with previous generations. But, it is somewhat doubtful whether the present generation of *students* is on a par intellectually with previous generations. It is common knowledge that more and more students of lower ability are remaining in high school than formerly. It may be assumed reasonably that among this "new group" are greater numbers whose reading ability is also lower. Hence the average level of reading ability

Several of Mr. Mallinson's papers have been published in past issues of *The Science Teacher*, the last prior one being "Narration in Films for Science" in the November, 1950, issue. Since then he has completed a number of parallel studies of vocabulary and reading difficulties of science textbooks. This article summarizes his chief findings. It should prove informative and helpful to teachers who wish to consider seriously how to overcome the obstacles to optimum use of textbooks as tools for learning.

George and Mrs. Mallinson have agreed to keep NSTA supplied with up-to-date bibliographies of science text and reference books. Apart from professional duties (he is professor of education, Western Michigan College of Education, Kalamazoo), the Mallinsons have a four-year-old son and a one-year-old daughter to keep them busy.

[1] Malatesta, Anne. "Dry As Chalk Dust." *The American Biology Teacher*, XII (February, 1950), pp. 27-8.

[2] M. Anthony Payne, O.S.B. "Some Queries, Mr. Editor." *The American Biology Teacher*, XII (May, 1950), pp. 108-9.

of particularly the high school population is probably lower than that of high school populations of a few years ago.

It is, however, probably impossible to determine whether instruction in reading in the public schools is adequate or whether it is generally less effective than it was a number of years ago. This matter is still a subject of much debate, and there is no evidence that the debate will be resolved in the near future.

Despite any evidence with respect to the type of student now in school, or the effectiveness of reading instruction, the question still remains, "Are textbooks in science too difficult for students for whom they are designed?" Such a question is out of the realm of speculation since in the last few years a number of investigations have provided abundant evidence with respect to the answer.

Curtis Summarizes Problems

The "milestone" among the earlier investigations was the one undertaken by Curtis.[3] In his investigation he summarized the results of 100 investigations in vocabulary found in textbooks for science and formulated these conclusions:

(1) Pupils encounter in science textbooks many technical and non-technical words the meanings of which they do not know. (2) There is insufficient provision in science textbooks for repetition of difficult scientific terms. (3) Too large a percentage of the difficult words in such textbooks are non-scientific or non-technical. (4) Too small a percentage of the scientific terms that are introduced into such textbooks of science are defined.

Flesch Formula Follows Word Count

A series of investigations [4,5,6,7] in the same area appeared 12 years after the study by Curtis. These investigations, however, involved the use of the Flesch formula,[8] rather than the "word count" that was used generally in the earlier ones.

[3] Curtis, Francis D. *Investigations of Vocabulary in Textbooks of Science for Secondary Schools.* Ginn and Company. Boston. 1938. Pp. viii, 127.

[4] Mallinson, George Greisen, Sturm, Harold E., and Patton, Robert E. "The Reading Difficulty of Textbooks in Elementary Science." *Elementary School Journal,* L (April, 1950), pp. 460-3.

[5] Mallinson, George Greisen, Sturm, Harold E., and Mallinson, Lois M. "The Reading Difficulty of Textbooks in Junior High School Science." *School Review,* L (December, 1950), pp. 536-40.

[6] Mallinson, George Greisen, Sturm, Harold E., and Mallinson, Lois Marion. "The Reading Difficulty of Textbooks in High-School Biology." *The American Biology Teacher,* XII (November, 1950), pp. 151-6.

[7] Mallinson, George Greisen, Sturm, Harold E., and Mallinson, Lois Marion. "The Reading Difficulty of Textbooks for High-School Physics." (Scheduled for publication in *Science Education*).

[8] Flesch, Rudolf. *The Art of Plain Talk.* Harper and Brothers. New York. 1946. P. 197.

No Evidence of Progress

One might well assume that during the period of 12 years between the two series of investigations considerable progress would be made in providing textbooks in science that were more suitable for students. However, there is no evidence that such is the case. In all fairness it must be stated that the conclusions formulated in the two series of investigations are not directly comparable since (1) different systems for evaluating the levels of reading difficulty were used, and (2) the conclusions themselves do not deal with exactly the same aspects of reading difficulty. Yet, the conclusions from the later investigations are substantially in accord with those from the earlier one. They are as follows:

1. Some of the textbooks in science for the middle grades of the elementary school tend to be quite difficult with respect to levels of reading difficulty. Some of the textbooks for the upper grades of the elementary schools are likely to cause some difficulty for the average student, and are likely to be quite difficult for the below-average student.

2. In general, textbooks for junior high school science are not likely to cause difficulty for the average student, although they are likely to cause some difficulty for the below-average student. Further, some passages in all of the textbooks are likely to be difficult for all but the superior student.

3. The textbooks for high school biology and for high school physics tend to fall into three groups, (a) easy, (b) moderately difficult, and (c) difficult.

   a. The easy groups are comprised of the lowest quarters with respect to reading difficulty, the moderately difficult, the second and third quarters, and the difficult, the fourth quarters. All groups vary significantly with respect to difficulty from their adjacent groups.

   b. Textbooks of both biology and physics, falling into the easy groups, are not likely to be difficult for students ordinarily taking these courses.

   c. Those in the moderately difficult group, except for certain passages, are not likely to be difficult for other than the below-average student. Such passages are likely to be difficult for any student in the courses for which they are designed.

   d. Those in the difficult group are likely to be difficult for any students in the courses

for which they are designed. Some books are even likely to be difficult for college students.

4. Nearly all textbooks for science contain some passages that are difficult for students for whom they are designed.

Many Books Will Cause Trouble

Thus the evidence in general seems to indicate that many textbooks in science are likely to cause difficulty for students in the courses for which they are designed. However, the mere identification of such a "trouble spot" is not very encouraging. Nearly all teachers use the textbook to a greater or lesser degree. Such a dependence does not seem unwise according to the following opinion expressed in the Forty-Sixth Yearbook of the National Society for the Study of Education: [9]

> In general, what seems likely to prove most satisfactory is to select a basic textbook that provides a good general outline of the course and primary text materials which all the class may be expected to study and then to supplement this foundational material with a variety of materials from other textbooks, periodicals, and reference works. . . . Also, it (the use of the textbook plus supplemental materials) possesses the important advantages of providing not only a foundation of minimal essentials common to all the class but also a definiteness of sequence and of continuity which a course based on miscellaneous reference materials rarely possesses.

The opinions expressed in the last statement are supported to a limited extent by the findings of Stafford.[10] In essence, Stafford concludes that the time and effort involved in assembling and organizing materials to replace the textbook are not justified by the results that are obtained.

Certain Implications Evident

It would seem reasonable to state here that, although a complete answer has not been made to the first question, certain implications have been made that cast some light on the answer to part of it. It would seem desirable therefore to deal with the second and third questions. Hence, the recommendations that follow will fall into two categories, namely, "What the teacher can do to make the most effective use of a textbook that may have passages that are difficult for the students," and "What the publisher can do to provide textbooks that are suitable with respect to level of reading difficulty."

What the Teacher Can Do

1. There is sufficient evidence to indicate that the teacher should consider the level of reading difficulty as a criterion in selecting a textbook. Since in most schools a textbook is used for at least three years, the time and effort involved in evaluating the levels of reading difficulty of the various textbooks are amply justified. It should be emphasized strongly, however, that the easiest textbook is not necessarily the best textbook. In the opinion of the writer many of the textbooks that were easy with respect to reading difficulty had little other merit.

There are a number of means for evaluating the level of reading difficulty, among them being the Flesch formula already mentioned. Further, Buckingham and Dolch [11] have assembled a number of "word count" systems in one publication. It might be suggested that both a "word count" and the Flesch formula be used. The "word count" fails to consider as a factor in difficulty the number of words in the sentences. The Flesch formula, in certain cases, may fail to indicate a certain passage as difficult merely because the words have few syllables. It is obvious that certain words of one or two syllables may be difficult.

2. The teacher should exert caution in considering a textbook difficult merely because of a "technical vocabulary." In every science course there are certain terms that must be mastered in order to assure maximal learning. The lists of "essential" and "desirable" terms for various science courses may be found in the investigation by Curtis already mentioned. Hence, a sampling of pages from a textbook should be made, and the technical vocabulary checked against these lists in order to determine whether or not it is excessive.

3. Assuming that a certain textbook has been selected, it is necessary to make sure that the vocabulary therein is not likely to prove to be a stumbling block to the students. Lists should be made of the terms in the technical vocabulary *and* the non-technical vocabulary that are rated by the word lists as being above the reading levels of the students in the course. It should be remembered that the lists should contain words of a grade level or two lower than the scholastic grades of the students. A term of the correct grade level of difficulty for the average student may prove difficult for the below-average student. It is obvious that these terms should be identified before the students come in contact with them.

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[9] *Science Education in American Schools.* Forty-Sixth Yearbook of the National Society for the Study of Education. Part I. Distributed by the University of Chicago Press. Chicago. 1947. P. 48.

[10] Stafford, Wayne. "The Effect of The Use of a Textbook As Compared With Supplemental Material In Teaching Biology." Unpublished master's thesis, University of Michigan, 1951. Pp. v, 69.

[11] Buckingham, B. R. and Dolch, E. W. *A Combined Word List.* Ginn and Company. Boston. 1936. Pp. iii, 185.

4. The teacher should have duplicated these lists of difficult terms together with their meanings and should then distribute them to the student. Prior to the time that they appear to the student, specific instruction should be given in their meanings and use. There is no evidence that mere contact with the terms and their meanings will assure understanding.

5. Whenever the terms appear in the text or in new contexts, they should be discussed until they have been mastered.

What the Publisher Can Do

1. It would seem advisable that publishers, during the preparation of their textbooks, should check constantly by means of word lists and the Flesch formula the levels of reading difficulty of the textbooks. This suggestion, of course, does not apply generally to the majority of publishers. However, with respect to certain difficult passages in nearly all textbooks, the suggestion does apply to most publishers.

2. There should be provided in all textbooks, perhaps as a glossary, a list of the technical vocabulary that should be mastered in order to assure maximal learning in the course. It would seem desirable that in such a list both the phonetic spellings and the meanings should be included. The technical vocabulary should of course be kept to a minimum. But, it should be sufficiently comprehensive to be in accord with the viewpoint expressed by Sister Payne. These policies have been adopted by many, but not all, of the publishers of textbooks for science.

3. The difficult non-technical terms should be kept at a minimum. It was noted in many of the textbooks for science that there were many non-technical terms that could have been replaced by synonyms within the vocabulary levels of the students for whom the books are designed. In such cases the value of using difficult non-technical terms is doubtful. Such a policy would of course be in accord with the viewpoint of Malatesta.

4. When a term from the technical vocabulary or a difficult non-technical term appears in the textual material, it would seem desirable to define or explain the meaning of the term, either in the textual material or as a footnote. It would seem desirable also to use the term in several contexts in the same or adjacent paragraphs. Thus the student will be given opportunity to generalize its meaning, and the effect of practice will be operative.

CHEMISTRY TODAY

by HARRY C. BIDDLE and GEORGE L. BUSH
HORACE G. DEMING, Technical Editor

High school chemistries are quite similar in content. They include the same facts and principles, and follow in general the same sequence in treatment. The following unique features of CHEMISTRY TODAY, therefore, are noteworthy.

1. Complete treatment of Periodic Table and Atomic Structure given in one chapter, early in the book. The discussion of atomic fission is scientific, not popularized, and is within the range of the average high school course.
2. Vocational Opportunities in Chemistry. This special topic is a feature of ten different chapters. It appeals to girls as well as boys in high school.
3. Organic Chemistry. Unusually large treatment of this important phase of chemistry.

Our representative will be pleased to show you this new chemistry.

RAND McNALLY & COMPANY

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CLASSROOM

ideas and demonstrations

Biology

Introducing Photosynthesis

By WALTER P. LARTZ, General Science Department, U. S. Grant School, Sheboygan, Wisconsin

A novel, introductory method of presenting the process of photosynthesis to classes of junior high students has proved successful. And the results have been excellent—particularly in the retention-span obtained of the basic ingredients which go into the food manufacturing process in the plant.

H_2O, CO_2, and sunlight are the main ingredients in this process.

H_2O is represented by clear water itself.

CO_2 is represented by water colored blue with water-color paint (represents "blue" air).

Sunlight can be represented by water colored yellow with water-color paint.

Mix the clear water and the blue water, and the result is a lighter blue. Mix the resulting light blue water with the yellow water, and the result is *green* —the color of plant leaves!

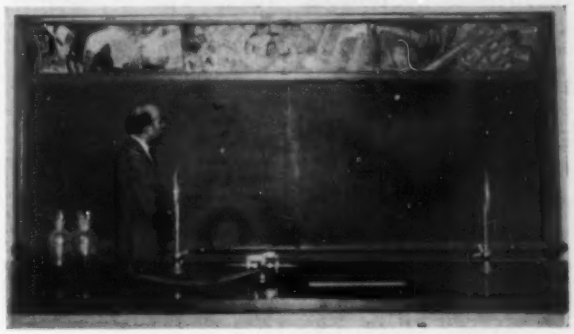
Although this method is not accurate (which fact should be stressed to the class), it does offer a novel approach and emphasizes those important ingredients so necessary for the manufacture of food in the plant. Teaching by the use of analogy can be risky. What we are interested in here is the *idea* of photosynthesis; the facts about the actual process must come later.

Chemistry

A Mural for the Chemical Laboratory

By HAROLD J. ABRAHAMS, Instructor in Chemistry, and HAROLD S. KIMMELMAN, Student in Chemistry, Central High School, Philadelphia, Pennsylvania

Most teachers feel a keen pleasure whenever an opportunity for correlation between their own subject and an altogether different one offers itself. Very regrettably such opportunities are all too infrequent, and a large proportion of such two-sided endeavors are probably the result of a conscious effort to bring them about. It is, therefore, a cause for rejoicing when a teacher of chemistry encounters a student who is interested in both art and science. This unusual combination having made its appearance in one of the present collaborators, Harold S. Kimmelman, the idea of a mural which would depict



the evolutionary spirit of chemistry suggested itself. The results are presented herewith.

Science, which is the basis of so much in life, is the theme of the painting. To suggest the richness of the adventure that is science, it seemed appropriate to use bright and glowing color tones. A medium was selected which would best develop and present the feeling of texture, as well as that of such forces as heat and light. Lastly, but of great importance, was the question of selecting media for a painting to be located in a chemical laboratory where it would forever be at the mercy of corrosive and otherwise active fumes. This necessitated the very judicious and scientific selection of resistant pigments.

The medium used was oil over tempera. An underpainting in terra-verte, burnt sienna, and zinc white provided the illuminating effects that could be amplified with color to the desired quality. The mural was painted upon a gesso-board, a surface used by the old masters, and now having a modern comeback. The surface is very pleasing and resembles that of plaster.

The spirit of science is caught up in the changing rhythm from primitive to modern, the simple naive pattern on the left side of the mural evolving on the right into an overpowering network of angles, prisms, and lines, all acting as they would in scientific progression. The primitive motif flows with even motion towards the center into which the modern motif breaks with noisy syncopated rhythm. In the center stands the symbol of that indispensable requirement to progress—the process of learning and teaching.

The two ends of the mural produce contrast. At the right, the great, powerful gear wheel (A′) is the antithesis of the antiquated water wheel at the left, (A); yet each wheel individually provides the terminal spaces with strength and contrast equal to that of the central mass. In further contrast is seen at the left of the picture the elements of nature doing man's bidding, while at the right those created by man are at work—i.e., the water wheel on the left opposed to the gear wheel on the right, windmill (B) on the left opposed to gasoline engine (B′) on the right. The alchemist (C) at the left side and the chemist (C′) at the right provide a double contrast. Historically, the blatant personality of the alchemist was important, his work being of secondary significance. This is suggested by representing him in the foreground and his work in the background. Modern chemical manufacture has lost much of this personal nature, a fact which is stated in the mural by the foreground position of the work and the rearward position of the modest worker.

The play of old against new is re-emphasized by the next figures—the ancient retort (D) and the modern reflux condenser (D′). At this point the primitive motion merges with the center, but the modern continues to surge towards the midsection of the mural. Great factories in the near distance form the somber playground of the chemist. The huge ladle (F) is visible behind the controlling test tubes, so vital in the control and regulation of the product. Through the smoke that pours from the factory chimneys the electronic diagram declares the pattern of universal creation. A numerical symbol, the square root of three, chosen for its adaptability to the space, as well as its beauty of line, announces the important role of mathematics.

Architecture, too, has its "day in court." Where the left blends into the center, a building (E) symbolizes city planning and at the same time sustains the scientific mood of the mural. Just as the factories formed the background for the right side, so books serve in this capacity for the central figures, consisting of teacher and students engrossed in the learning process. Nearby an X-ray tube radiates upon a model of a compound molecule, setting the stage for a future in which light will guide.

The atmosphere created by this picture is both pleasing and inspiring. A chemical laboratory can be drab and, to some students, a very foreboding place. We believe that this mural adds a human touch to the room and contributes a cheery friendliness previously absent. There is no longer any

need to say with John Joachim Becker (1660) "The chemists are a strange class of mortals who seek their pleasures among soot and flame, poisons and poverty. . . ."

This report would be far from complete without expression of deepest thanks to Mr. Frederick J. Gill, a member of our art department, for his wise counsel and very valuable help.

General Science

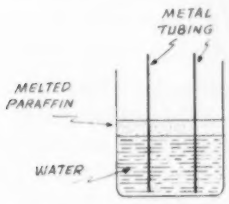
An Automatic Sprinkler System Head

By ALBERT F. GILMAN, JR., Director of the Laboratory, Central YMCA Schools, Chicago, and ABRAHAM RASKIN, Associate Professor and Coordinator of Sciences (Teacher Education Program), Hunter College, New York City

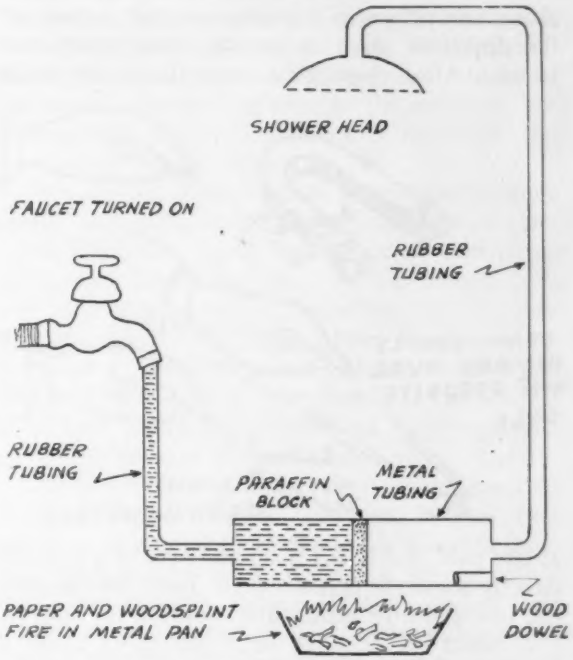
One of the difficulties encountered in teaching science is the standard demonstration which frequently fails to work properly. One demonstration in this category is the automatic sprinkler head model employing a shower head which has been covered with a layer of paraffin.

The writers have found that the apparatus diagrammed below is much more reliable than the standard demonstration.

To prepare the tubing, first pour a quarter-inch layer of melted paraffin over the surface of some hot water contained in a beaker. Then place the piece of metal tubing into the beaker (see diagram on the left), and allow the paraffin to cool and harden. The tubing is then withdrawn and the paraffin on the outside of the tubing scraped off with a knife.



In the commercial automatic sprinkler systems installed in restaurants, department stores, laboratories, and other establishments, each orifice is covered with a copper disk which is held in place by a pair of sprung levers. The levers, in turn, are held in position by a low-melting-point alloy composed of cadmium, bismuth, and lead. The alloy can be varied in composition so that it will melt at any of a wide range of temperatures, say, 165 degrees F. to 360 degrees F. When the heat of a fire melts the alloy, the levers open and pull the copper disk away from the orifice, releasing the flow of water.



The orifices are not plugged directly with the low-melting-point alloy because it has been found that the low temperature of the water at the orifice may be sufficient to resolidify the alloy and close off the orifices.

The demonstration described is similar to the commercial apparatus in that the low-melting-point material is not used to fill the openings from which the water will issue, but serves as a kind of fuse.

In the demonstration there is little danger that the paraffin will resolidify, in the heated metal tube or elsewhere in the system, into a form which

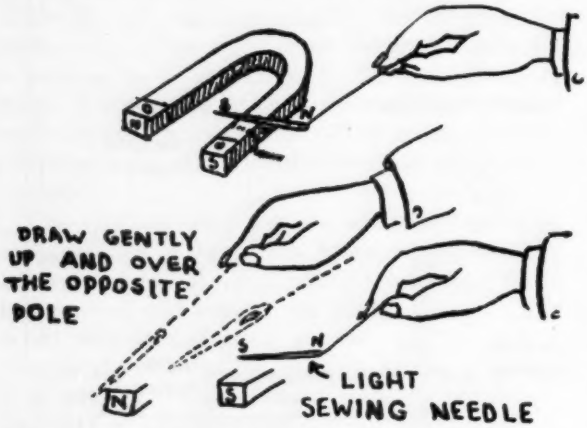
will shut off the flow of water if the following precaution is taken. Secure a small piece of glass tubing or wood dowel near the point where the metal tubing joins the glass tubing leading to the shower head. This will have the effect of tilting the melted piece of paraffin and will allow the water to flow by it into the rubber tubing and to the head.

Elementary School Science

Some Unusual Experiences with Magnets

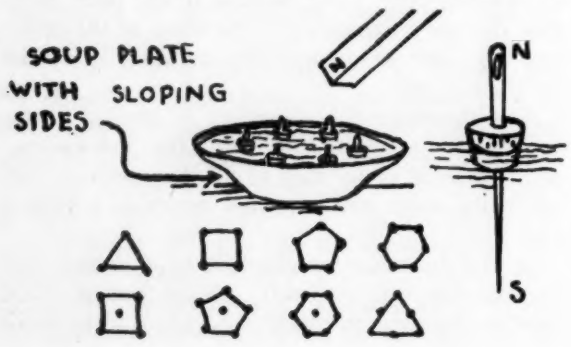
By GUY V. BRUCE, Professor of Science
State Teachers College, Newark, New Jersey

1. To cause a threaded needle to float in space above one pole of a horseshoe magnet, follow out the directions given in the two illustrations that follow. After thoroughly magnetizing the needle

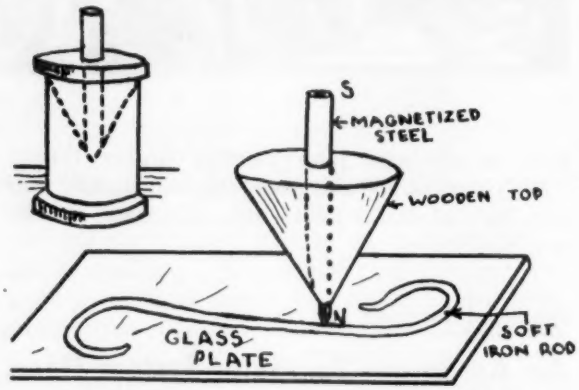


at one pole, slowly lift it up and over to a position directly above the opposite pole. Keep the threaded end taut and from being pulled down to the magnet.

2. Select six or seven small flat corks about a half-inch in diameter. Force magnetized sewing needles through the corks so that the upper ends all have the same polarity. Float the corks in a large dish or tray of water. One end of a bar magnet will draw all the corks to the center of the dish, and the other will drive them away again. Other patterns are suggested by the illustration.

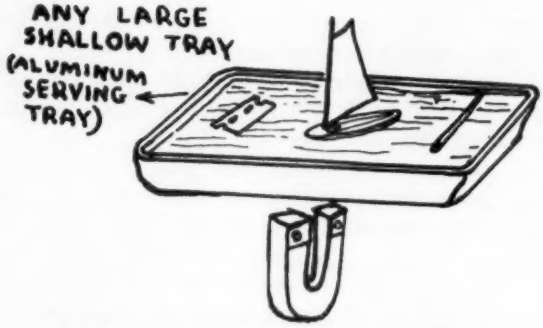


3. This may be called the obedient top. How to make the top and how to demonstrate its "obedience" are shown in the drawings. A sheet of cop-

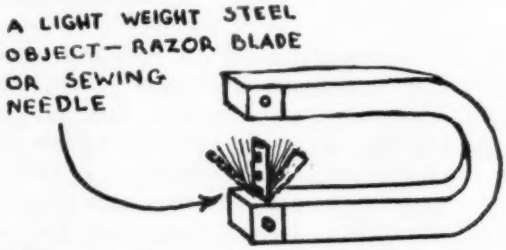


per, aluminum, zinc, or other material that is transparent to magnetism may be substituted for the glass. A 12-inch length of iron wire will serve for the magnetic track.

4. The next illustration suggests how it is possible to propel small, magnetized objects floating on water. A strong magnet will "reach" right through a table top, etc., and move the objects around.



5. Weird behavior of a double-edged razor blade placed between the poles of a horseshoe magnet can be demonstrated as shown. It will stand per-



pendicular to either pole as if hinged to the magnet. If struck with the finger, it will vibrate as if the "hinge" has a spring attached.

PRECIPITATES

Announcements, News, and Views of Current Interest

Two recent booklets worthy of serious consideration for use in general science and biology are these: *The Puzzle of Food and People* by Amabel Williams-Ellis and *Food for All.* The former was published for UNESCO and the latter resulted from a cooperative project centering in the NEA Committee on International Relations and the department of Elementary School Principals. It is described as "a sixth grade experience." Order the UNESCO booklet from Manhattan Publishing Company, 225 Lafayette Street, New York City 12 (60 cents a copy). The NEA booklet is priced at 50 cents with discounts for quantity orders.

Many science pupils have had lots of "fun with gears" by using the Judy Company's Mek-N-Ettes. Now there is a Mek-N-Ette Junior. It would appear intriguing and instructive for upper elementary youngsters. For still smaller children another new Judy toy has just been announced—Judy's Clock. For information on these, write to the company at 310 North Second Street, Minneapolis 1.

Ten high school seniors last June received scholarship awards of $1000 each in the annual, nationwide competition conducted by the American Institute of Steel Construction. The winners may enter accredited institutions of their own choice to undertake training in civil engineering. The 52 competitors, all of whom took college entrance examination board tests, came from 19 states and were nominated by steel fabricating companies. The jury making final choices included representatives from Columbia University, Stevens Institute of Technology, Hoboken, New Jersey, and Newark, New Jersey, College of Engineering.

Recipient of the Scientific Apparatus Makers 1952 Award in Chemical Education, to be presented for the first time at a spring meeting of the American Chemical Society, was announced at the Diamond Jubilee meeting last September. The $1000 award and a gold medal will go to Dr. Joel H. Hildebrand, dean of the chemistry department, University of California. Dr. Hildebrand's *Principles of Chemistry* and *Reference Book of Inorganic Chemistry* (with Latimer) are widely known and used by high school teachers. Born in Camden, New Jersey, he holds the B. S. and Ph. D. from the University of Pennsylvania. Dr. Hildebrand has been on the faculty of the University of California since 1913.

Recommended—that you write to General Biological Supply House, Inc., 761-763 East 69th Place, Chicago 37, and ask to be placed on their mailing list to receive *Turtox News.* Give complete name and school address. Informational briefs, tips on teaching, and announcements of teaching materials are some of the reasons why this little booklet has been so popular with biology teachers.

The Silver Anniversary meeting of the National Association for Research in Science Teaching will be held in Chicago, February 14-16. Meetings and headquarters will be at Hotel Congress. For information and reservations write to the secretary, Dr. Clarence M. Pruitt, Oklahoma Agricultural and Mechanical College, Stillwater.

Pointing out that "mental illness affects more people than polio, heart disease, and cancer combined," and that "most families are so unprepared for mental illness that they do not behave in a way to insure the patient's receiving the best possible treatment," the Public Affairs Committee has produced a pamphlet on the subject, titled *When Mental Illness Strikes Your Family.* The address is 22 East 38th Street, New York City 16. PAC pamphlets are now 25 cents each.

The editors of *Student Life* have pointed out that this publication carries numerous articles that would be of interest to science teachers and to those who want helpful ideas concerning science activities. For example, during 1950-51 *Student Life* carried 21 articles dealing specifically with science. Among the titles of these student-written contributions were "Tomato Culture," "Scientific Crime Detection," "Plutonium Plant," "Personalized Projects," and "Megacycle Club" to name only a few. This journal is the official organ of the National Honor Society. For information and subscriptions, write Walter E. Hess, managing editor, National Association of Secondary School Principals Association, 1201 Sixteenth Street, N. W., Washington 6, D. C.

Recently released is the fourth annual report on *Teacher Supply and Demand in the United States.* Prepared by Dr. Ray C. Maul for the NEA National Commission on Teacher Education and Professional Standards, the report portrays the situation in 36 pages of tables, facts, and figures. Copies may be obtained from the NEA ($1.00 a copy).

NSTA Activities

▶ *Midwinter* Meeting of NSTA and AAAS Science Teaching Societies

For the fourth straight year the midwinter meeting of NSTA will be held jointly with the American Nature Study Society and the National Association of Biology Teachers, under the umbrella of the American Association for the Advancement of Science.

Philadelphia is the city; December 27, 28, 29, and 30 are the dates; Hotel Adelphia is the location of all sessions and of NSTA headquarters. Now is the time to make hotel reservations; *use the reservation form on page 221.*

NSTA will offer a greatly expanded program this year. There will be sessions having special appeal to teachers of elementary school science, health, biological science, and physical science. One full session will be devoted solely to teaching demonstrations and materials for various levels and fields of emphasis. Another session will focus attention to high school science and problems of scientific manpower.

The Business-Industry Section of NSTA will hold its annual business meeting the morning of Thursday, the 27th, followed by an open luncheon and an afternoon program.

The social life of the science teacher will be nourished by a buffet supper at the dinner hour on Thursday. Afterward there will be the annual ANSS showing of Kodachromes, followed by the all-societies mixer. Other unscheduled social activities will doubtless go on at other times.

Each of the three morning sessions will be joint meetings with all three societies participating. To open each day's program on the 27th, 28th, and 29th there will be a showing of new science teaching films beginning at 9:00 a.m.

Those planning to attend this joint meeting should be on hand for the opening whistle Thursday morning—and should plan to remain through Saturday afternoon at least, and Sunday, the 30th, if possible. In addition to the science teaching sessions, other attractions include the Junior Scientists Assembly, the ANSS-NABT field trip (Sunday), and various AAAS offerings such as the Annual Exposition of Science and Industry, the science theater, the president's address, and certain symposia. One symposium in particular will attract numerous science teachers; namely, that of Section Q (NSTA cooperating) on "the program of teacher education in science."

In all, about 30 program participants are listed for NSTA sessions alone. To mention only a few, here are some of the "names" you can see and listen to (and argue with, if you think they should be argued with) at Philadelphia, December 27-30: Glenn O. Blough, specialist for elementary science, U. S. Office of Education; Hubert N. Alyea, professor of chemistry, Princeton University; Paul Brandwein, head of science department, Forest Hills High School, Forest Hills, New York; M. H. Trytten, director, office of scientific personnel, National Research Council, Washington, D. C.; Suan Brown, science coordinator, Atlanta, Georgia; E. Laurence Palmer, professor of science education, Cornell University; Richard M. Sutton, professor of physics, Haverford College; and Elbert C. Weaver, teacher of chemistry, Phillips Academy, Andover, Massachusetts.

Sorry we can't name them all. But you'll see full details in the December issue of *The Science Teacher,* and a printed program will reach you around December 10. Let's make it a date!

Program Committee.

▶ *Spotlight* on Manpower for Science and Engineering

The current and probable long-range critical shortages of scientists, engineers, and technical personnel are now receiving attention and serious study in several quarters—but mostly at collegiate levels and beyond. However, the Thomas Alva Edison Foundation is convinced that secondary schools occupy a key position and play an extremely vital role in the maintenance of supply.

Already much concerned with the *quality* of precollege instruction in science, as evidenced by the First National Institute for Science Teachers last May, the foundation now turns the spotlight on the *quantity* aspect. In West Orange, New Jersey, November 12-13, the foundation will sponsor a special Institute on "Development of Improved Understanding of the Modern Industrial State and

the Central Role Played by Engineers and Scientists in its Strength and Growth." Once again NSTA enjoys the role of prime cooperator in planning and conducting the Institute. Other official cooperating groups are the AAAS, the NEA, and the U. S. Office of Education.

The foundation has issued invitations to attend to some 60 persons who have direct lines of communication with leaders and students at secondary and elementary levels. School superintendents, high school principals, vocational guidance counselors, representatives of teachers of science, mathematics, social studies, and English, and high school student representatives have been included.

First day of the Institute will be devoted to historical and statistical presentations which will provide the springboard for action. The participants will break up into smaller working groups the second day. They will try to come up with answers to the question, "What are some positive actions that can be taken to produce early and long-term effects in harmony with the objectives of this Thomas Alva Edison Foundation cooperative program?"

Specific questions to be considered include the following. How can we arouse vital interests in science and technology among pupils of high mental abilities? Recognizing at the high school level that "knowledge keeps no better than fish," how can science be kept fresh and realistic? How can the secondary school teacher come into first-hand contact with modern engineering and science? Through historical and biographical approaches, how can a broader and deeper understanding be developed of the human qualities of great personalities in engineering and science? How did the leaders make their contributions? How can the interrelationships of science and technology be interpreted in a meaningful, interesting way so as to show their impact on civilization? How can we keep open the multiplicity of channels by which we can discover talent and encourage it to rise to its own level?

As one step toward linking the TAEF-NSTA program with the efforts of other groups, the executive secretary of NSTA described past, current, and planned endeavors on September 28 at the Manpower Convocation of the Engineers Joint Council, University of Pittsburgh.

CALLING ALL GADGETEERS!

Help make the Philadelphia meeting a memorable one. The NSTA Committee on Apparatus and Equipment invites all science teachers to exhibit teacher- and student-devised demonstrations, apparatus, and teaching ideas. Improvised or home-made charts, models, diagrams, and maps from all teaching levels will be welcome. No idea is too simple or elementary.

Send a brief description of your proposed exhibit to the chairman of the committee without delay: Dr. Walter S. Lapp, 724 Derstine Avenue, Lansdale, Pennsylvania. State the general nature of the exhibit, its purpose, the area required, and indicate whether the electric current will be needed. The exhibits will be on display in Hotel Adelphia Friday and Saturday, December 28 and 29.

Evaluators of Business-Sponsored Teaching Aids

Members of NSTA appreciate the packet service and regard it as one of our most helpful membership services. However, perhaps some do not realize the magnitude of that important "first step" in the preparation of the packets—*evaluation*. Each potential packet item is reviewed by 15 evaluators. They send evaluation reports to the headquarters office where an overall summary is prepared and the decision revealed as to the suitability of including the item in a packet.

To date 17 issues of the packets and ten individual mailings have been distributed free to members of NSTA. A total of about 150 titles have been included. Since five times as many items are reviewed as are approved and distributed, multiply 150 by five and again by 15, and you can see that our evaluators have prepared some ten thousand reports on business-sponsored teaching aids. Now divide by 70, the average number of evaluators serving on the committee. Each evaluator has averaged about 160 reports, or 40 a year for the four-year life of the packet service.

It is indeed small recognition of their untiring efforts and helpful service to publish the names of the members of this group. Only the current list of evaluators is given, but our thanks also go to several who have served in the past.

Maurice U. Ames, New York City
Lyle D. Anderson, Waterloo, Iowa
Frederic G. Arnold, Livingston, New Jersey
Margaret C. Carroll, Dorchester, Massachusetts
Ruth E. Cornell, Wilmington, Delaware
Hubert J. Davis, Portsmouth, Virginia
Lydia Elzey, State College, Pennsylvania
Marion E. Engel, York, Nebraska

Elmer A. Finch, Amityville, New York
Earl R. Glenn, Upper Montclair, New Jersey
Harley F. Glidden, Greeley, Colorado
Aaron Goff, Newark, New Jersey
Philip Goldstein, New York City
Pauline Gratz, New York City
Millard Harmon, Auburndale, Massachusetts
Mrs. H. Edward Haslem, Haledon, New Jersey
George Hennings, Ridgefield, New Jersey
John C. Hogg, Exeter, New Hampshire
Agnes S. Holdahl, Albany, New York
Elizabeth B. Hone, Los Angeles, California
J. H. Jensen, Aberdeen, South Dakota
James A. Keech, Castleton, Vermont
R. E. Keirstead, Wethersfield, Connecticut
William G. Kessel, Terre Haute, Indiana
Jerome Kuderna, Auburn, Alabama
Louis Kuslan, New Haven, Connecticut
Richard H. Lape, Buffalo, New York
Florence W. Leech, Syracuse, New York
Ernestine Long, St. Louis, Missouri
Colin McEwen, Hollywood, California
Morris Meister, New York City
Robert Molkenbur, St. Paul, Minnesota
Mother Mary Charlotte, S.H.C.J., New York City
Greta Oppe, Galveston, Texas
Robert F. Paashaus, Elizabeth, New Jersey
Elra M. Palmer, Baltimore, Maryland
Robert B. Patch, Pepperell, Massachusetts
K. Ellsworth Payne, Portland, Oregon
Dorothy V. Phipps, Chicago, Illinois
Fred T. Pregger, Paterson, New Jersey
Elizabeth N. Pukas, Palm Springs, California
F. A. Riedel, Stillwater, Oklahoma
Herbert A. Smith, Lincoln, Nebraska
Harold S. Spielman, Bronxville, New York
J. Albert Starkey, Vineland, New Jersey
D. C. Stroud, Des Moines, Iowa
J. F. Swartzendruber, Marion, Iowa
James I. Swientek, Chicago, Illinois
Wayne Taylor, Denton, Texas
G. R. Tracy, Long Beach, California
Anna Vafiades, Long Island City, New York
Kenneth E. Vordenberg, Cincinnati, Ohio
Warren T. Warnecke, Mt. Vernon, New York
Elbert C. Weaver, Andover, Massachusetts
Hanor A. Webb, Nashville, Tennessee
Elizabeth Lockwood Wheeler, Mount Pleasant, Michigan
Robert K. Wickware, Windham Center, Connecticut (Now on leave in Japan)
Harry H. Williams, New York City
John D. Woolever, Detroit, Michigan
Herbert S. Zim, Urbana, Illinois

The most widely used secondary school text in earth science

FLETCHER'S

EARTH SCIENCE, Revised Edition

Easy to read, easy to teach, with an interesting style and illustrations that really illustrate, *Earth Science* is kept at the level of the high school student's understanding. Special features of the text include summaries in the form of self-tests, an appendix on maps, and general review questions. Teacher's Manual. Laboratory Manual.

BOSTON NEW YORK CHICAGO ATLANTA
SAN FRANCISCO DALLAS LONDON

D. C. HEATH *and Company*

PHYSICAL SCIENCES FOR HIGH SCHOOLS. John C. Hogg, Judson B. Cross, and Elbert P. Little. 531 pp. $3.96. D. Van Nostrand Company, Inc. New York. 1951.

AS STATED in the preface the viewpoint of the authors in presenting this book is that "everyone should know something about the basic principles and laws of physics, chemistry, geology, meteorology and astronomy—the so-called physical sciences." The text was developed in the classroom and tried out in manuscript for eight years with annual revisions and amendments before reaching its present form.

The subject matter is divided into 11 units which deal with the nature of things, the earth, temperature and heat, weather, fire and fuels, power from combustion, electricity, light, communication, structural materials, and the universe. The chapters within the units are quite short, containing usually six to eight pages of text, a summary, questions, and one or more suggested projects. In addition there are review questions and a reading list at the end of each unit. All questions and references are listed in two groups according to difficulty.

The double-column format is used, and there are numerous photographs and diagrams. Incorporated into the text are directions for a number of demonstrations. Most of these are familiar to the experienced teacher, but in addition to being helpful to new teachers there is an advantage in having them available to the students.

Much of the material is traditional in its presentation with the historical approach being used often. Mathematical concepts are not stressed, although they are not avoided when needed for understanding. Frequent mention is given to practical applications of principles, and, of course, the more recent scientific advances are included.

Perhaps to many teachers the greatest deficiency of this textbook will be the lack of constant and conscious effort to teach the use of the scientific problem solving method and to develop scientific attitudes. One feels that these may be implied in the method of presentation but finds them seldom stated. The major emphases seem to be factual knowledge and understanding of laws and principles.

JEAN MCGREGOR
Washington, D. C., Public Schools

200 MILES UP—THE CONQUEST OF THE UPPER AIR. J. Gordon Vaeth. 207 pp. $4.50. The Ronald Press Company. New York. 1951.

THE STORY of modern scientific research on the nature of the atmosphere at altitudes beyond the present range of piloted flight. The book presents an interesting factual account of the spectacular firings of captured V-2's and powerful American rockets, as well as the use of plastic balloons ("flying saucers") and airborne instruments. The author, an aeronautical engineer in the U. S. Navy Special Devices Center of the Office of Naval Research, condenses into a few hundred readable pages the facts about the upper air verified by these flights and the unusual methods used to obtain instrumental readings. *200 Miles Up* provides a rich source of accurate, up-to-date information and background material of both theoretical and practical importance.

MARY ELLEN BRAIN
National Science Teachers Association

ATOMIC ENERGY IN WAR AND PEACE. Capt. Burr W. Leyson. 217 pp. $3.75. E. P. Dutton & Company, Inc. New York. 1951.

THE SUBJECT is presented accurately and in a simple and concise form. Six chapters are devoted to war use of atomic energy, and three chapters to the peaceful use. Two chapters are built around the atom and detection of radiation. The book deals with all the major aspects of atomic energy as the publishers claim. Its 217 pages indicate to the reader that it does not pretend to be completely comprehensive. It is rather a gleaning of the more appealing aspects of the subject.

The author becomes involved in unfortunate political discussions in several sections, predicts war with Russia as a reason for producing the "H" bomb, and criticizes the government's anti-trust activities when citing the contribution made by big business to the atomic energy research program. The contribution to, and the control of, the atomic energy program by the Atomic Energy Commission and the political reasons for this control are ignored by the author. The book might best serve to stimulate student reading in more authoritative sources.

KEITH C. JOHNSON
District of Columbia Public Schools

WORLDS IN THE SKY. Caroll Lane and Mildred Adams Fenton. 96 pp. $2.50. John Day Company. New York. 1950.

ANOTHER of the fine books pioneered by this combination of authors. It contains information for parents, teachers, and for grownups who want to bring their knowledge of the universe up-to-date. Beautiful and bounteous illustrations with the large and easy-to-read print make this an outstanding and attractive book. The vocabulary is carefully selected for the upper elementary pupils. The book would be excellent as a source of supplementary material for the slow reader.

HUBERT J. DAVIS
Norfolk County Schools

OUR WONDERFUL EARTH. Herbert Townsend. 152 pp. $2.50. Allyn and Bacon. Boston. 1950.

A VERY READABLE and delightfully illustrated book dealing with the Heavens Above, the Earth Beneath, and Life on the Earth. The last section is divided into a chapter on plants, one on animals, and a chapter on people of the earth. The different colors used with the illustrations make the book very attractive. The material is scientifically accurate and presented well. The ideas stimulate and challenge pupils. The material is selected and the vocabulary designed for pupils in the elementary grades, but this would be an excellent source book for supplementary material for the slow reader in the junior high school.

HUBERT J. DAVIS
Norfolk County Schools

EVERYDAY WEATHER AND HOW IT WORKS. Herman Schneider. 189 pp. $2.75. Whittlesey House. New York. 1951.

HERE IS a simplified story of weather, what makes it, how it works, and some of the things we can do about it. Written by the man who serves as supervisor of elementary science in the New York City schools, this book should find a ready welcome among teachers at this level and among the pupils of about grade five or six upward—upward even into the eleventh and twelfth grades.

The detailed instructions on how to make a weather-forecasting station out of simple, everyday items found around the house should provide for several hours of interesting activity on the part of boys and girls. And teachers, too, for there's nothing like doing it yourself before you sic the kids on it! Starting on page 125 is quite a collection of things to build and use in "Measuring Moisture," "Watching the Wind," and "Examining the Air." They're of the sort that got Mr. Schneider that nice write-up in a late summer issue of *Life* magazine.

Every page of the book is illustrated with eye-catching and informative drawings by Jeanne Bendick. The text is factually correct, and the discussions are clear and nontechnical. However, the book does not put the teacher out of a job. Many teachers will want to explain further a passage like this (p. 15): "If you leave a piece of dark paper in the sunlight for five minutes, it will feel hot to the touch. Put another dark paper next to it for only one minute, and you will find that it is only slightly warm. The more time in the sunlight, the warmer it gets. Heat piles up." Or this one (p. 76): "Stay away from wire fences. Lightning goes for long metal objects, especially if they are fastened into the ground."

However, it would be quibbling to call such statements inaccuracies. To this reviewer, *Everyday Weather and How It Works* seems to hit its mark admirably.

ROBERT H. CARLETON
National Science Teachers Association

Ideal Chemistry Course

(Continued from page 243)

wage. True, the teacher may have other subjects to teach, and numerous extracurricular chores.

But do not deceive yourself. Teaching chemistry today is not an occupation where a person can earn a salary large enough to support a moderately large family in comfort and eventually own a home of his own. The income will support a single person or a small family of modest tastes. But if you expect a moderately large family, or if your tastes are educated, discriminating, and expensive, and you have failed to marry a rich spouse, and you have children to educate, some supplement to your income is necessary.

Teaching in the evenings, teaching during summers, processing photographs, running a travel agency, painting houses, selling insurance, baby sitting, raising chinchillas, coloring Christmas cards, are all jobs that will serve. Also, learn right away how to manage a garden so that you will have something to eat during the summer.

A tradesman was talking to a factory worker about the job offered to his daughter who had recently graduated from college. The figure mentioned for wages was considerably lower than the young lady could have earned by going into the mill, but, boasted the proud parent, "Them's good wages for an educated person."

Books Received

Basic Horticulture. Victor R. Gardner. (Revised Edition.) 465 pp. $4.75. The Macmillan Company. New York. 1951. A beginning text in horticulture designed to give the student a real understanding of plants—their structure, how they grow, and the way in which they react to different environments.

A New Theory of Gravitation. Jakob Mandelker. 25 pp. $2.75. Philosophical Library. New York. 1951. A new theory of gravitation harmonizing with the polar nature of electrostatic and electromagnetic fields and based on the premise that radiation is a manifestation of force directly opposed to gravitation.

These "coupon service" pages announce the availability of free and low-cost teaching aids for science. Those that are business-sponsored have been reviewed by the NSTA Evaluation Committee and approved for distribution by the Association. To procure copies of desired items, fill out the corresponding coupons and mail these, together with any remittance required, to the NSTA Executive Secretary, 1201 Sixteenth Street, N.W., Washington 6. Watch these columns for additional offerings in future issues of *The Science Teacher*. (Print or type coupons.)

THE EDISON EFFECT. *Thomas Alva Edison Foundation.* Second in a series of booklets describing Mr. Edison's principal inventions. The first, *The Incandescent Light*, was distributed in NSTA Packet XII. Authentic and very readable, beautifully illustrated. This booklet is informational for teachers and useful to students of junior high school age and older. Foreword by Charles F. Kettering. 72 pp.; 50 cents.

SAFE USE OF ELECTRICAL EQUIPMENT. *National Education Association.* Booklet for teachers, laymen, and students. Provides information, teaching suggestions, and quiz. Produced cooperatively by NSTA and National Commission on Safety Education. Special price to NSTA members only, 25 cents (50 cents to non-members).

Please send me ..... copies of **The Edison Effect** at 50¢ each. (Remittance enclosed.)

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OPPORTUNITIES IN ATOMIC ENERGY. *Vocational Guidance Manuals.* Informational book covering all aspects of atomic energy and providing a wealth of vocational guidance information. See review, *The Science Teacher*, October, 1951, page 218. $1.00.

HISTORY OF COPPER, BRASS, AND BRONZE. *Copper and Brass Research Association.* Informational booklet well suited to use in general science and chemistry. Illustrations, some suitable for opaque projection. Free.

SCIENCE TEACHERS' GUIDE FOR WOOD EXPERIMENTS. *Timber Engineering Company.* Instructions and study questions for 18 experiments with wood. Useful for group activities and for special projects. Suitable for general science, biology, chemistry, and physics. Prepared in consultation with NSTA. Fifty cents a copy. (*Wood Study Kits*, including wood samples, manual, and special magnifying lens, $8.50.)

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PARTS OF A DRY CELL. *Burgess Battery Company.* Cardboard chart picturing cut-away dry cell and showing relative position of each part. Also provided, information sheet on kit of raw materials for classroom construction of dry cells. Free. (Kit of materials for assembling 25 dry cells, $5.12.)

MEDICAL USES OF BLOOD—A MANUAL FOR SECONDARY SCHOOL TEACHERS. *American National Red Cross.* Report of committee of American Association for Health, Physical Education, and Recreation. Questions and answers on the composition and functions of blood and procurement and uses of blood as a medicine. Includes suggested student activities, suggested integrations, a brief quiz, and a list of resource materials. Free.

SAFETY THRU ELEMENTARY SCIENCE. *National Education Association.* Designed to help teachers of upper elementary grades make safety an integral part of their science instruction. Suggests scientific principles which can be explained to children in terms of hazards and desirable practices. Areas treated include toys, tools, and machines; electricity; fire; animals; plants. 40 pages; 50 cents.

THE FIRE TRIANGLE. *National Education Association.* Teaching materials prepared jointly by National Commission on Safety Education and National Science Teachers Association. Each unit includes bulletin-board poster in color, instructional suggestions for teachers; and 40 copies of a pupil's quiz. 25 cents per unit.

Please send me ..... free copies of **Medical Uses of Blood —A Manual for Secondary School Teachers.**

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Please send me ..... copies of **Safety Thru Elementary Science** at 50¢ each. (Remittance enclosed.)

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Books Received

Bacteriology. Robert E. Buchanan and Estelle D. Buchanan. (Fifth Edition.) 678 pp. $6.00. The Macmillan Company. New York. 1951. A basic text with particular emphasis on modern developments in cellular morphology and physiology and to the many technologies in which microoganisms are significant.

Geography of the Pacific. Otis W. Freeman, Editor. 273 pp. $10.00. John Wiley & Sons, Inc. New York. 1951. A description of the geographic setting of the Pacific, followed by a discussion of its islands and their people, resources, and industries. Over a dozen contributors joined in its preparation.

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